MGIPC—S4—III-1-93—22-8-45—7,000.

THE GARDENER'S BUG BOOK

The Gardener's Bug Book

1,000 INSECT PESTS AND THEIR CONTROL

by Cynthia Westcott

WITH 100 FULL-COLOR ILLUSTRATIONS
BY EVA MELADY
AND 100 LINE DRAWINGS BY
EVA MELADY & J E EDMONSON

Edited by F. F. Rockwell

The American Garden Guild, Inc.
AND
Doubleday & Company, Inc., 1946

PRINTED IN THE UNITED STATES
AT
THE COUNTRY LIFE PRESS, GARDEN CITY, N. Y.

FIRST EDITION

PESTS

The rose-bug on the rose
Is evil—so are those
Who see the rose-bug
Not the rose.

ELLA M. BOULT

EDITOR'S FOREWORD

THE PROBLEM WHICH WE PRESENTED CYNTHIA WESTCOTT, WELL-KNOWN and widely experienced Plant Doctor, in writing *The Gardener's Bug Book,* was to give the amateur—even the most amateurish amateur—a volume that would enable him to control any insect plant pest he would be likely to encounter in his garden or about his grounds, in any section of the United States.

It was indeed a difficult and a very complicated problem, but we felt that if anyone could succeed in accomplishing it, Dr. Westcott was that person, for its solution required not only a scientific knowledge of insect pests and their ways, and of the most up-to-date materials and techniques for combating them, but also—*and of equal importance*—a knowledge of the particular problems of the homeowner, and of how to discuss them in such a way that he could readily, and really, understand them.

This Dr. Westcott is particularly fitted to do. For years, in addition to her professional consultation work, she has personally taken charge of plant pest control in the gardens of clients—among them the very lovely garden of Helen Hayes at Nyack, New York. This experience, coupled with the answering of letters from thousands of gardeners all over the country, and garden club lecture tours through many states, has provided her with a most unusual and intimate knowledge of the plant pest problems of the amateur gardener.

In selecting the list of pests to be covered in this volume, entomologists, practical gardeners, and experiment stations all over the country have been consulted. The resulting "black list of 1,000"—out of several thousand candidates for this questionable honor—covers pretty much every pest *likely* to be encountered in any state. Fortunately, as Dr. Westcott points out, only a tiny fraction of this total can be expected in any one

garden in any one year. The rub is that there's no way of foretelling just which ones to expect; therefore it's necessary to be prepared to fight any of them.

The Gardener's Bug Book puts you in that position. It does this first by enabling you to identify the pest; second, giving you the specific controls which have been found effective against it; and third, telling you how *and when* to apply them. A novel and a most valuable section of Dr. Westcott's book is the one which gives an alphabetical list of *plants,* with the pests which attack them, and the type of injury they cause. So even if some new bug, worm, or grub is a complete stranger to you, you can quickly track the villain down—*if* he is a villain; sometimes he will turn out to be an excellent friend.

The life cycle color plates by Eva Melady—which have won high praise even from critical entomologists—and line drawings in the text present a rogues' gallery of nearly 200 of the most important pests.

While the information which Dr. Westcott gives is presented in such a way that even the garden beginner can grasp it, it is thorough and complete. In most books on plant pest control for the amateur, aphids, for instance, are dismissed in a paragraph or two, with reference perhaps to half a dozen different species. Dr. Westcott lists and describes 107 kinds, and gives a general account of the fascinating habits of these tiny but destructive creatures and the slaveowner ants that exploit them, which is as hard to stop reading as a mystery story.

The Gardener's Bug Book is a thick volume (it had to be, to be *thorough*) on a none-too-glamorous subject. But frequently a flash of Dr. Westcott's dry humor lightens a passage and serves to make some fact stick in one's memory. We feel that she has done an exceptionally difficult job exceptionally well; that this work (to use a hackneyed phrase where it really *does* apply) fills a long-felt want, and will for many years remain one of the most useful and most used books in any gardener's library.

Of one thing I am certain: no gardener can possess this book without having a far better garden than he could have had without it.

F. F. Rockwell

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LIST OF COLOR PLATES

INTRODUCTION

THIS IS THE BOOK I HAVE WORKED ON FOR A LONG TIME, BECAUSE I needed it on my own desk to answer your many questions. Maybe if it is on *your* desk you will be able to find the answers to most of your own questions, and my own neglected garden will get a few more spare moments of attention.

Probably an apology is in order for a book on entomology written by one who is not a trained entomologist, and has learned her insects the hard way, through having to subdue them in her own and in many other people's gardens. About half of the pests considered here are personal enemies, if "enemies" is the right word for creatures who provide me with a livelihood as a plant doctor. Some of the rest are insects met in garden visits across the country. I have not personally sprayed camellias for tea scale, nor azaleas for peony scale, nor pittosporum for cottony-cushion scale, nor crape myrtle for aphids; but I have stayed long enough in the South to see these insects, and many, many more, and to realize the need for action by gardeners.

I have never sprayed California Christmasberries for lacebugs, but I have met them in that year-round garden state; and I have also seen, out there, whiteflies on fuchsias, Diabroticas devouring roses, webworms spoiling lawns, and more slugs and snails than an eastern gardener ever dreams of.

Once, when I was lecturing in Iowa on a below-zero winter day, I remarked that I had never met a boxelder bug face to face. Whereupon the amused garden club members told me to look down at the rug I was standing on! But those Iowa gardeners had never met a Japanese beetle, so we were even.

The one comforting thing in pest control is that injurious insects are

pretty well divided up around the country. No one section has more than its fair share. When you bewail the fate that seems to have sent bugs just to your personal address, keep in mind that others are wailing over a lot you don't have, so you're not without company. You also have some company when you set out to subdue those bugs; although the number of bewailers will always be larger than the number of subduers.

This book, then, is written largely from face-to-face combat with insects known intimately in day-by-day contests; partly from insects known casually in passing, and partly from insects met in books—many, many books, and many, many articles in periodicals, bulletins, and circulars, to the authors of which I express my profound appreciation. It has been said that getting all your material from one author is plagiarism, while getting it from many authors is research. On that basis much of this book might properly be termed research.

In order to acknowledge my debts properly, and hoping to start some gardeners at least on a little research of their own, I have listed elsewhere in this volume some of the books in my library which show the thumbprints of frequent consultation.

My grateful thanks go to Eva Melady for the inspiration of her lovely color plates, and to both Miss Melady and Ellen Edmonson for the many fine line drawings.

CYNTHIA WESTCOTT

Glen Ridge, New Jersey
May, 1946

HOW TO USE THIS BOOK

THE PURPOSE OF THIS BOOK IS TO HELP YOU PREVENT INJURY BY PLANT pests to the things that you grow in your garden and about your grounds. It is designed as a working manual, to be referred to as occasion may arise, not as a book to be read through and then set aside.

But before using it as a manual, before attempting to look up information on any specific pest, please read Chapter I for a general picture of insects in gardens and types of control measures.

Next, read the first part of Chapter II, on Garden Chemicals, carefully, thoroughly, and repeatedly. In fact, it may save future heartaches if you copy the questions under Stop, Look, and Listen! and attach them to your garden medicine shelf. At least skim through the list of chemicals, to know the types available and their general functions, and then come back for special information before using any particular chemical.

Don't think of applying any chemical without consulting Chapter III, paying particular attention to the sections on Making Up Spray Mixtures (noting the dilution tables on pages 42 and 43), Timing the Spray, Spray Injury, and How to Clean a Sprayer. If you prefer dusting, check its advantages and disadvantages.

Chapter IV orients insects in the animal kingdom, tells you how they are made and grow, prerequisites to later identification, and how and why they are named.

Having got this background information there are two methods by which you can locate in these pages the information you may be seeking, at the moment, on any particular plant enemy.

FIRST: *If you know the common name of the pest,* look it up directly in Chapter V, The Bugs. Here insect groups are in

alphabetical order: ANT LIONS, ANTS, APHID LIONS, APHIDS, ARMYWORMS, BEES, BEETLES, BIRDS, BOLLWORMS, BORERS, BUDMOTHS, BUGS, and so on. Under each such heading there is a general discussion of group characters and often some general control measures, followed by specific insects arranged alphabetically by their common names, with interpolated discussions of insect sub-groups or families. For instance, if you want information on the rhododendron lacebug, turn to BUGS for characters common to all true bugs, pause briefly at **LADYBUGS** for distinguishing family traits, then follow along to R for **Rhododendron Lacebug** for detailed information to supplement the general picture.

SECOND: *If you do not know the name of the pest* look up, in the alphabetical list of Host Plants beginning on page 417, the plant or plants attacked; note the most likely prospect—borer or caterpillar, mealybug or aphid, et cetera—and see if you can identify it in the Bug section. Under many hosts you have only two or three choices, so the checking back is simple; in other cases there are many possibilities, so these must be checked off, one by one.

In case of doubt, consult the Index, which includes the scientific name of the insect, the common name under which it is described in this volume, and other common names which may be more familiar to you.

In putting into effect suggestions for *control,* make certain that you employ the specific type of insecticide indicated, and follow directions exactly. Above all, keep in mind that *prompt action* is all-important in winning a victory in the war with plant pests.

THE GARDENER'S BUG BOOK

Chapter I

INSECTS IN THE GARDEN

INSECTS IN THE GARDEN ARE NOT NEW. THEY WERE PROBABLY WAITING for Adam and Eve in the Garden of Eden and they have been aiding, and bedeviling, every gardener since that time. There is a lament in the Bible (Joel 1:4) which sounds very modern: "That which the palmerworm hath left hath the locust eaten; and that which the locust hath left hath the cankerworm eaten; and that which the cankerworm hath left hath the caterpillar eaten."

It is difficult to estimate the exact amount of injury to agricultural crops caused by insects. For many years it has been the assumption, based on scattered crop surveys, that insects take at least 10 per cent of every crop. To that loss we have to add the cost of labor and insecticides now used to keep the damage as low as 10 per cent; and also the losses, which show up in plant-disease surveys more often than in insect surveys, caused by plant diseases which are carried and spread by insects.

This one tenth of our crops fed to insects is, of course, a rough average; in any one garden, or on any one farm, in any one season, and on any one plant, the loss may be nearly 100 per cent. Sometimes crops are so ravaged by insects that they are plowed under rather than harvested; sometimes root nematodes are so well established in a soil that almost no vegetables or ornamentals can be grown. Sometimes Japanese beetles eat up all the open roses, or thrips ball up the half-open blooms, or midge destroys the buds almost before they have started.

Or perhaps bark beetles may bring Dutch elm disease and death to that lovely old elm which persuaded you to buy that particular lot for your home. Or perhaps, for three or four successive springs, you neglect to have the elm sprayed for cankerworms and elm leaf beetles, and as a result it dies. The general rule is that one year's complete defoliation

from insects may kill an evergreen, while three continuous years of foliage loss may spell death to a deciduous tree.

It is hard to estimate losses of ornamental trees in dollars and cents. They have a definite assessable cash value, depending on the type of tree and location, but the personal loss to you may be much greater. The late Dr. E. P. Felt gave some interesting figures several years ago. At that time the basic value of a good shade tree in a desirable location was considered about one dollar for each sectional square inch of the trunk at breast height. On this basis an elm with a 10-inch trunk would be worth about seventy-five dollars; one with a 20-inch trunk about three hundred dollars. As much as five thousand dollars has been offered, and refused, for a particularly fine specimen elm, for it meant more to the owner than the money.

A single camellia shrub, or one of the ancient azaleas of the South, may be worth several hundred dollars. Usually home-garden insect losses are entirely outside the official figures available. In 1944 the Chief of the Bureau of Entomology and Plant Quarantine stated that insects destroy about two billion dollars' worth of food and fiber annually in the United States. Omitting the enormous cost of insects harmful to man, animals, stored foods, and clothing, here are a few miscellaneous examples, gleaned from many sources.

The boll weevil is considered our primary crop pest. During the years from 1910 to 1928 the average loss due to this insect was calculated at 11.5 per cent, with the loss from other cotton insects bringing the total to 15.5 per cent. For recent years the figures are probably higher. It has been stated that if the cotton losses were evenly divided every man, woman, and child spends ten dollars a year more for cotton goods because of the boll weevil.

The next pest on the destructive list is the cotton bollworm, which, in other sections, is known as the corn earworm and the tomato fruitworm. In the Middle West the percentage of infested corn ears often runs between 50 per cent and 75 per cent even though the kernels actually eaten may not be more than 4 per cent. About 2 per cent of all tomato fruit is ruined by this insect.

The third enemy, the spruce budworm, ruins pulpwood to the tune of more than seventy million dollars a year.

Other pests in more or less descending order of importance are the chinch bug, Hessian fly, codling moth, Colorado potato beetle, cucumber beetle (working chiefly on corn, under the alias of corn rootworm), bark beetle, plum curculio, potato leafhopper, apple aphid, San Jose scale, peachtree borer, black scale, wireworm, cabbage worm, red scale, pea aphid, and Mexican bean beetle.

In 1938 J. A. Hyslop, in charge of the Insect Pest Survey, estimated that the combined loss caused by our 73 most important pests, together with the cost of insect control, and the loss caused by insects as carriers of disease, was $1,601,527,000.

During the period from 1929 to 1940 potato farmers, from combined pest and fertilizer problems, lost enough potatoes to feed three million people a year.

Southern extension services figure that cotton farmers can get $2.00 to $7.00 more per acre by following control recommendations. The expected loss for an average year now is 296,822,000 pounds of cottonseed oil needed for human food; 864,000,000 pounds cottonseed meal and cake for livestock feed; 520,000,000 pounds of cottonseed hulls; 120,000,000 pounds cotton linters for munitions; and 1,294,000,000 pounds cotton fiber for clothing.

In 1942 it was figured that the amount spent in teaching entomology, in extension service, research, and actual control operations by state and Federal agencies was $15,000,000, or about 1 per cent of the total cost of insects to our chief commercial crops.

Until recently no one paid much attention to the cost of insects to the home gardener, but in the November 1944 issue of the *AIF News*, put out by the Agricultural Insecticide and Fungicide Association, it is stated that the potential market for their products is the 35,000,000 families listed in the last United States census, that 95 per cent of these families already have flower gardens, and that 87 per cent of the flower gardeners and 75 per cent of the vegetable gardeners use insecticides. The estimate for the small-package market was about $20,000,000 a year. I should like to know more about just how the surveys were made before accepting the fact that 87 per cent of the gardeners actually *use* insecticides, instead of just having them on a shelf in the garage or toolhouse; but if they do, the educational problem of trying to teach all these people just how and why and when to spray, and how to choose the right chemical, becomes enormous. This book can do little more than scratch the surface.

INSECTS AND PLANT DISEASES

It was not until 1891, when it was shown that bees spread the bacteria causing fire blight of apples and pears, that growers started to think about the part played by insects in distributing plant-disease organisms. Now we know that a great many diseases are spread by insects, along with other agencies, and that some diseases can be transmitted *only* by insect

carriers, known as "vectors." Among these diseases are bacterial wilt of corn, transmitted by flea beetles; bacterial wilt of cucurbits (cucumbers and their pals), carried by cucumber beetles; lily mosaic, requiring the melon aphid as a vector; leaf roll of potatoes, spread principally by the green peach aphid (which also transmits 21 other viruses!); Dutch elm disease, carried by bark beetles; curly top of sugar beet, spread by the beet leafhopper; aster yellows, transmitted by the six-spotted leafhopper; and peach yellows, spread by the plum leafhopper.

ARE INSECTS INCREASING?

There are more insects in our gardens now than our grandfathers had to fight, although not so many more as we fondly believe. Part of the increase is only apparent; we know how to recognize more insects, we are much more conscious of insect injury, and we now expect crops to be more nearly perfect than we did in earlier days. But as for the much-talked-of freedom from pests in the early days—well, just let me quote a few statements from J. F. Houser's *History of Insect Control Developments,* prepared for the seventy-fifth anniversary of the Ohio State Horticultural Society and summarized in the *AIF News:*

"Courses in economic entomology were taught for the first time in America in 1867, at Michigan and Kansas Agricultural Colleges, to supply a need sensed even then for trained workers to combat insect pests."

"The first (1867) report of the Ohio Agricultural Society stated that many of the apples of that year's crop were defective and wormy; also that the currant worm had invaded the state and growers must stop its spread."

"One of the worst insects in the '70's was the plum curculio, mentioned time and again as a pest of plums, cherries, apples, and peaches. So severe did this insect become that some growers abandoned plums."

"The codling moth was mentioned by name for the first time in 1868.

"In 1869 the Society heard that the Colorado potato beetle had reached Evanston, Illinois, on its march eastward. Five years later the president said in his annual address: 'We are now masters of the situation.'"

In 1892 the Legislature made its first appropriation—$400—to investigate control measures for the rose chafer.

"In 1893 San Jose scale was discovered in Clermont County and again the cry arose 'stop that bug.' . . . The scale spread. Trees died by the thousand, partly from the insect, partly from the radical treatments attempted."

One reason why pests have been increasing through the years is our American habit of growing one crop over huge acreages without much crop rotation. Such a system is a cordial invitation to insects to come and multiply unchecked.

We bring in new insects by our habit of introducing foreign plants. One or two bugs get smuggled in, despite precautions, while the natural enemies of those bugs get left behind in their native country. When insects get started without their natural checks they really go to town, as all of us who live in the Japanese-beetle area can testify.

The annual report of the United States Bureau of Entomology and Plant Quarantine in 1944 gave some idea of the possibilities of insect entry.

Thirteen thousand and ninety-three airplanes were inspected, with 3,219 carrying prohibited plant material, much of it from places where it is known to be the host of injurious plant pests. The 681 actual interceptions of insects included citrus blackfly, Mexican fruitfly, West Indian fruitfly, Mediterranean fruitfly, pink bollworm, and a whitefly—all potentially capable of causing great losses if established here.

Other types of transportation inspected included: 19,596 ocean ships, 4,473 carrying prohibited materials; 69,184 freight cars coming from Mexico; 74,580 foreign parcel-post packages, with 1,086,750 plant shipments in transit in this country; 34 carloads of Christmas trees and 245,062,663 board feet of lumber; 88,643 trucks, which revealed 4,779 Japanese beetles hitch-hiking South in returning empty trucks. 39,504 insects, representing 918 species, were stopped at ports of entry.

Sometimes insects arrive in most unusual ways. Who would suspect, for instance, that dishes imported from England would be a source of the Dutch elm disease? But the wood used for crating the dishes brought with it bark beetles, and the beetles carried the fungus spores.

INSECTS OF VALUE TO MAN

Discouraging as the insect-pest picture seems, the balance is still on the credit side for insects, not only for their useful products, but also for their help as scavengers, as pollinators, and in other ways.

Insects as food for fishes and birds are rather important. Young nestling birds eat more than their weight in soft-bodied insects each day. In 1848, when the Mormon cricket threatened starvation for Utah, great flocks of California gulls arrived to save the day. Many other birds eat predatory insects, but they make no distinction in their diet between harmful and beneficial insects. Instead of depending on birds to protect us from

insects we may have to protect enough insects from our sprays to feed the birds which are such a joyful part of the garden.

Insects, larvae of mosquitoes, gnats, blackflies, and others, furnish two thirds of the food supply for fresh-water fish. Now we are worrying about the possibilities of DDT killing the fish. I don't see that it matters much whether DDT kills fish directly or by slow starvation by killing the mosquitoes. We'll probably have to pay some price for freedom from pests.

Insects in industry are used in a number of ways. Silk depends on the silkworm (or it did before the days of nylon); shellac comes from the lac insect, a scale; some dyes from cochineal, another scale; honey and wax from bees.

Insects in surgery and medicine are not so common as they once were. Blister beetles are used to some extent as medicine but no longer for blistering purposes. Maggots used to clean out wounds in World War I have apparently given place to sulfa drugs.

Insects as scavengers play a large role in our national life. Dead bodies of animals would be a menace to health and would produce unbearable odors were they not swiftly taken care of by insects. They clean up wastes on garbage dumps, help in the compost pile, hasten the decay of dead trees and other vegetation.

Insects as plant pollinators were credited, in 1929, with making possible crops valued at $2,087,833,000. About 85 per cent of all our plants are pollinated by insects, and with many fruits cross-pollination by bees and other insects is essential. Honeybees transfer about 90 per cent of the pollen in apple orchards. Pears, which are self-sterile, depend on bees and other insects. Most commercial varieties of sweet cherry, and nearly all Japanese plums, are self-sterile. Peaches are mostly self-fertile, but insects are needed to transfer the pollen from stamens to stigma of the same flower. Strawberries are either self-sterile or self-fertile. Blackberries, dewberries, and raspberries require insects even to fertilize themselves. Vegetable crops are much the same as fruits, some being self-fertile, but pollination by insects being the normal procedure in many species.

Insects as predators and parasites on other insects are of far more value to gardeners than most of us realize, but we won't stop to dwell on these good-neighbor insects here, for you will meet them time and again in these pages.

WAYS OF CONTROLLING INSECT PESTS

Control of plant pests is not limited to spraying and dusting operations. First we have natural control, factors influencing the numbers of insects

without regard to man; then legal control or exclusion to prevent the introduction of pests; cultural control, including sanitation; biological control; control by mechanical and physical measures; and finally control by chemicals.

Natural control is by climatic factors or physical characters of a country, or by the presence of native enemies—insects or other animals or diseases.

Not many insects live in all climatic zones—arctic, temperate, and tropical. Winter temperatures restrict the range of some; some prefer a warm, moist climate; others like a hot, dry climate; some can fly or be carried by the wind for long distances; others can crawl only a short distance.

Large bodies of water usually check natural spread of insects, as mountain ranges do also. The character of the soil limits certain pests, wireworms flourishing chiefly in poorly drained soils, nematodes in sandy soils.

Birds, moles, shrews, skunks, snakes, lizards, newts, salamanders, and toads live largely on an insect diet. Of these, the toad is very efficient, devouring four times the capacity of its stomach every 24 hours. Birds consume enough insects to more than pay for the cherries, strawberries, grapes, corn, et cetera, that they also eat. Skunks eat a lot of grubs—compensation for the rather conspicuous holes they leave in lawns.

Control by exclusion, both legal and voluntary. The Plant Quarantine Act of 1912 provides that whenever it seems necessary, in order to prevent the introduction or spread of any dangerous insect or plant disease, the Federal government has the power, after a public hearing, to prohibit the importation, or shipment interstate, of any class of plants or plant products from any country or locality, and from any state or portion of a state or territory in this country. Such specific prohibitions are called *quarantines.* In addition to the Federal quarantines there are a number of state quarantines. Domestic quarantines are now in force against the gypsy and brown-tail moths, Japanese beetle, pink bollworm, Mexican fruitfly, and white-fringed beetle.

It is not expected that a quarantine can keep out a pest forever, but the expense of inspection service is justified if the insect is prohibited for a period sufficiently long to enable us to learn its life history, to develop control measures, and to introduce its parasites.

Along with quarantines the regulations may call for compulsory cleanup measures. In some states the property owner is given legal notice that he must, before a given date, take measures to control certain pests. If this is not done the town or city does the work and assesses the cost against the property as a tax.

As a home gardener you can make your own exclusion laws. Why, for

instance, borrow trouble by introducing a delphinium crippled up with cyclamen mite, or a Norway spruce with aphid galls, or a juniper showing scale?

Cultural control, including *sanitation,* is usually free from expense, except for labor costs; and sometimes it does not even require labor, merely a little planning, a little knowledge of the life histories of particular insects.

Although not always possible in the small garden, *crop rotation* is a fundamental principle in control of plant pests. Most insects attack a small group of related plants. Cabbage worms chew members of the cabbage family, the squash vine borer sticks to the curcurbit group, Mexican bean beetles don't like much except beans. By changing the plantings around you can starve out certain pests, can prevent their building up huge populations. However, in a small garden, with all vegetables confined in close quarters, changing location is of very limited help in pest control.

Soil cultivation during the season destroys some insects, and so does spading up in the fall, leaving the ground rough to expose larvae and pupae-ants, Japanese and June beetle grubs, larvae of the corn earworm and squash vine borer, wireworms, cutworms, and many others.

Correct timing is a control measure. In Connecticut snap beans can be planted during the early part of June and they will mature between Mexican beetle broods. Early summer squash will come along ahead of the squash borer, but early corn is most seriously injured by the European corn borer.

Resistant varieties are often thought of in connection with plant diseases, but the idea works for insects too. Most native plants have developed some degree of resistance to their pests. European varieties of grapes can be grown in this country only on native rootstock resistant to grape phylloxera. Often the character of the foliage keeps off pests. Leafhoppers, for instance, much prefer smooth to hairy leaves.

Destruction of crop residues, weeds, and trash—in other words, garden sanitation—is tremendously important. It is stressed in connection with nearly every insect considered in this manual and is the cheapest, easiest, most foolproof control measure for the amateur gardener. The wrong chemical may injure, but it never does any harm to clean up all old plant parts after harvest, compost some of the material, and burn anything capable of causing trouble another year. Clean up old iris leaves to get rid of borer eggs; make slugs homeless by burning old hollyhock stalks; burn over leaves and rubbish near turf to kill chinch bugs. Get rid of weeds, trash, and other protective cover for overwintering cucumber beetles, Mexican bean beetles, Colorado potato beetles, and many other pests you will meet later in the text.

Biological control is a sort of artificial restoration of the balance of nature, the bringing in of natural insect enemies, encouraging birds and predatory animals, introducing nematodes or bacteria or fungi which will work on the undesirable insects.

The wide publicity given DDT in all its reactions on good and bad insects has served to awaken us to the value of insect parasites and predators. Ordinarily the public does not hear very much about the lady-beetles which are being continually released to control scale, the red-spider destroyers, the hymenopterous wasps, and parasitic flies. Instead of a prolonged discussion here on these beneficial insects, they have been interpolated with the destructive insects, in their proper groups, for I think this will help in their recognition. I'd hate to have you step on a ground beetle, or squash a ladybeetle larva by mistake, so the good beetles are put right in with the bad beetles, the beneficial syrphid flies in the same group as the havoc-working cherry fruitflies.

When man starts monkeying around with the balance of nature he has to be awfully sure his system won't backfire and cause trouble in some other way. Once upon a time the pricklypear cactus was introduced from America into Australia, into one garden, to make a hedge to keep out rabbits. Soon it kept everything else out, and crops were impossible on some fifty to sixty million acres overrun by this thorny weed! Eventually, after long search, some insect enemies of the cactus were found and now they are busy reclaiming the land—for crops and rabbits.

Control by mechanical and physical measures. These are the barriers we erect between the plant and the pest: the wire fence (or the single electrified wire) against animals, such as rabbits; planting flower bulbs in wire baskets to protect them from mice and moles; wire guards to keep dogs off shrubbery or rabbits and mice away from orchard trees; tar-paper disks around cabbage stems against root maggots; the cylinder of paper or tin to keep cutworms away from young transplants; hotkaps to keep cucumber beetles off cucurbit babies. But why go on? You can think of numerous other examples.

Control by chemicals makes up the bulk of this book of bugs. The list of materials available today is given in the next chapter, followed by a general discussion of spraying, dusting, and fumigation. The application of these principles to specific cases is given under the individual insect, or groups of insects.

Chapter II

GARDEN CHEMICALS

NOT SO LONG AGO GARDEN WRITERS WERE IN THE HABIT OF TREATING all plant pests and diseases in a couple of pages stuck in the back of any book on gardening. They lumped all sucking insects in one category, all chewers in another, blithely recommended nicotine sulfate for the first, lead arsenate for the second, with sometimes an oil spray or lime-sulfur for a dormant treatment and, of late years, pyrethrum and rotenone as general cure-alls. So there you were, all set to take care of any problem!

Those days are gone! Actually they were never here, for the problem never was so simple as this sort of advice on control made it out to be. The theory was that if we talked very much about pests people would get scared and give up gardening; or maybe not even get started. So you were lured along under slightly false pretenses and you never stopped to realize just how much damage insects were doing in your garden until the war came along and you started growing vegetables.

Then you began asking for help on specific problems. You learned that if you did not subdue Mexican bean beetles they would leave you much the small end of the crop. You learned that you could pick a few squashes if you were lucky and then the borers would take over. And when garden writers finally found out that insects were one of the facts of life that could no longer be hidden from you, you began to get a little real information, and you started recognizing your insects and learning how they worked.

Deep down in our hearts all of us, gardeners and writers together, have cherished that secret hope, that lovely daydream, that when the war was over there would be one of those wonderful new chemicals that would take care of all pests at once without any work. Of course, when

we stopped to think, we could see how impossible such a thing would be—a chemical to kill all insects would be as devastating as the atom bomb; there would likely be no plant or animal left on earth if all the insects were killed.

When DDT arrived on the scene some people believed that here really was the way out, the easy way. Of course it wasn't true—no entomologist ever believed it was—but discounting all the ballyhoo, DDT used properly, on certain crops for specific insects, does a remarkable job. And so do many others of the new insecticides which mushroomed up during the war.

We are living in an age of specialization and the trend is all away from that cure-all idea. Now we choose a specific chemical for a specific insect. For the commercial grower this means better control with less plant injury. In fact, the control may be so much better that we'll either have to go back to plowing under crops or planting less acreage to keep the prices right for the farmer.

For the homeowner the new era means acquiring more specific knowledge about specific spray materials instead of just spraying on general principles. Combination sprays or dusts and other time-saving devices are still possible, but they cannot be used indiscriminately.

In this book I have made no attempt to separate plant pests into the usual 2 groups—the sucking insects and the chewing insects. Nor have I even separated the chemicals into "contact" and "stomach" poisons. Such a procedure seems only to complicate the picture, because the same material may work equally well on a chewing insect and a sucking bug, and yet react quite differently on 2 insects of the same type.

DDT, our most publicized new insecticide, effectively controls chewing Japanese beetles and sucking potato leafhoppers, yet it has almost no effect on Mexican bean beetles. It works fairly well on some aphids and not so well on others; and as for sucking mites—well, DDT just encourages them so that they flourish in superabundance where they were never even noticed before. The same specificity, perhaps in even greater degree, is true of other new insecticides.

No, there's no royal road ahead in pest control. It means *work!* You'll have to learn to read the labels on the bewildering array of proprietary compounds on your dealers' shelves, or the descriptions in catalogues, to know what the labels mean, which insects will be controlled, and, not least in importance, which plants are allergic to these chemicals.

You may think that all this is too much trouble, so you will play safe with the old stand-bys. But can you? Suppose you put some of that good old "safe" rotenone in your duster and start out to dust the melons or the cucumbers. You did not read the label so you don't know that the diluent or "carrier" used with the rotenone is sulfur; nor do you happen

to know that melons are violently allergic to sulfur. So you keep on dusting the vines every week. Result: no melons, but a lot of time and energy wasted.

Figure 1 is drawn from photographs* showing the results of dusting cantaloupes in Alabama for pickleworms. Plot B was treated with 1 part derris (rotenone), 1 part sulfur, 2 parts talc. The yield was only an average of 2.2 melons from 10 hills, whereas the plots *without any treatment* averaged 3.1 melons per 10 hills. But the plot shown in A was dusted with 1 part derris to 3 parts of talc, and produced 31 melons per 10 hills. That small amount of sulfur, only 25 per cent, meant losing 29 melons out of a possible 31. Ponder on that awhile!

Figure 1 A B

Sulfur injury on melon: A, vines dusted with rotenone; B, with rotenone combined with sulfur

Perhaps you think pyrethrum is surely a good old safe stand-by. And so it is. But most proprietary compounds come to you in concentrated form with a soap spreader and very little water. You make up the proper dilution for spraying, and then stop to do something else for a few hours, not realizing that pyrethrum is quickly dissipated in an alkaline solution and that soap in water makes an alkaline solution. When you finally get around to spraying you might just as well be putting on pure water for all the benefit your plants will get.

"But certainly," you say, "I can at least fall back on lead arsenate." Maybe you can, but I've seen a lot of cherries and peaches burned up with lead-arsenate spray mixtures made up for shade trees. Do you know the proper dilution, and how to add lime or zinc sulfate, or both, to make lead arsenate safe for peaches?

*Arant, F. S., *Journal Economic Entomology, 33*:842.1940.

STOP, LOOK, AND LISTEN!

Before using *any* chemical, in *any* form, at *any* time, on *any* plant, ask yourself these questions:

1. Do I know the active ingredient in this material, and is it formulated for use on plants? (There are two types of DDT preparations, one for household pests and pests of men and animals, and another for agricultural use; the same is true of thiocyanate sprays and some other materials.)

2. Is it specifically recommended for the insect I want to kill?

3. Is there any danger of its injuring the *plant* at the dilution needed to kill the insect?

4. Is there any diluent in this dust, or spreader in this spray, which may harm my plant? (Remember the cantaloupe and the sulfur.)

5. Are the weather conditions right for this chemical on this plant at this time? (Oil sprays injure all plants somewhat, evergreens severely, if used when it is too cold; copper puts red spots on rose leaves in cold weather, sulfur burns the tips when it is too hot.)

6. Have I used anything on this plant in the recent past which would either inactivate this chemical or be injurious to the plant when it mixes with this chemical? (Rotenone or cryolite is more or less inactivated in the presence of lime; sulfur dust used within a month of applying an oil spray may cause injury.)

7. Have I used any other material recently in this sprayer and forgotten to clean it out? (Once I saw hundreds of rose bushes spoiled for a whole summer because the sprayer had been used for a weed killer the day before the roses were sprayed, and no one had remembered to rinse it out. Tartar emetic and Salp are readily weakened in effectiveness by any foreign chemical.)

8. Have I measured or weighed the amounts correctly?

If you can answer these questions go ahead and spray, or dust. If you can't, hesitate. You can do more harm in 10 thoughtless minutes than the bugs can do in a whole season.

It all sounds as if I were trying to make out a case for plant doctors, doesn't it? I am, in a way. We don't expect laymen to dose themselves with sulfanilamide, or penicillin, or streptomycin. These marvelous but tricky chemicals are administered by doctors. In the same way DDT and DD and 666 and Sabadilla and Ryanex and all the other new wonder-workers ought to be administered by trained doctors. But right now there aren't any plant doctors to speak of, so you'll have to be your own.

This book is really intended to help you, not discourage you. Don't try to take it all in one dose; don't worry about any insects except those

that are bothering your own garden. Glance through the chemicals listed in this chapter, but don't try to remember all details. Everything is in alphabetical order; you can easily find the information later, if and when you have use for any one material.

I hope, however, that this book will also help you to persuade some of your sons and daughters to get the professional training necessary to become plant doctors. We need them all over the country. Speaking from experience I can testify that it is a healthy, happy, exciting life. What with the bugs and the garden owners there's never a dull moment! The abiding satisfaction of bringing a rose garden back into bloom when all of the new buds have been killed by midge, or of seeing a park full of azaleas glow with color when all those in surrounding untreated gardens are brown and collapsed, may not be so great as that of a doctor who has saved a human life, but it is pretty rewarding just the same. I commend it to the next generation.

Meanwhile, you who are gardening in this generation pay heed to my warning. If you don't know *what* you are doing and *why* you are doing it, you'll be better off to stick to sanitary measures—cleaning up crops after harvest, cutting off infested plant parts, and all the other things stressed with every insect discussed. And let the beneficial insects and birds, toads, snakes, and lizards work for you at no cost.

Remember, if you don't know what you are doing, don't do anything in the line of chemicals. It will not help to copy your neighbor—he's probably guessing too. *When in doubt, stop!*

CHEMICALS FOR GARDEN AND GREENHOUSE PEST CONTROL

The following list is arranged in alphabetical order without regard to type of action, whether by contact, or as a fumigant, or as a stomach poison. In compiling the material I have relied heavily on the 1945 edition of *Entoma*, a directory of insect and plant pest control, published by the Eastern Branch of the American Association of Economic Entomologists, which lists as completely as possible manufacturers and distributors of insecticides and fungicides. If your dealer has a copy of *Entoma* on his shelves he can get you anything you need which he does not have in stock. Some chemicals are sold chiefly in bulk to farmers rather than in small packages to home gardeners, but if enough of you demand materials in amounts suited to your needs, you'll get them.

There are listed in *Entoma* about 1,850 trade names of insecticides and fungicides, and something more than 800 of these are trade-marked in-

secticides for agricultural use. I have chosen from the 800 a few trade names to serve as examples of the types of chemicals discussed, but these are not "recommended" in any way; nor is it to be assumed that they are any more desirable than the many preparations omitted for lack of space.

Aerosol Sprays—The term aerosol refers to the method of distributing chemicals in uniform droplets. The insecticides are dissolved in a liquefied gas, such as methyl chloride or Freon, and kept in a metal container under pressure. Such containers are called "bombs"; and when a valve on the bomb is opened the contents are ejected as a very fine spray from which the solvent immediately vaporizes, leaving the insecticide suspended in air in minute particles. Such bombs, using either pyrethrum or DDT, were immensely useful to our armed forces during the war, and are now available to civilians for household pests. The bombs prepared for flies and mosquitoes are not designed for use on plants; but similar aerosols (using thiocyanates, nicotine, DDT, and other insecticides) have given successful results in greenhouses. The aerosol idea seems destined for rather wide commercial use for truck crops which can be treated under a trailing canopy to confine the vapor.

Aerosols are not yet applicable to outdoor home gardens, but the insecticide picture is changing so rapidly that this statement may no longer be true even a few months hence. The commercial grower, naturally, will be the first to have access to new methods and materials, but the small home-owner will not be forgotten.

Ant Baits, based either on sodium arsenite or thallium sulfite, are on the market under a wide variety of trade names: Ant-B-Gon, Ant-Chek, Ant Ded, Ant-Kill, Ant-Not, Antrol, Ant-X-Jelly. There are a great many others, but that gives you a general idea of the possibilities. It saves time and trouble, is safer, and probably cheaper for the small place, to purchase such poisons ready prepared.

Antimony Compounds—See **Tartar Emetic** and **Sodium Antimony Lactophenolate.**

Arsenic Trioxide (white arsenic) is too injurious for use as a spray on plants but has a place in poison baits for cutworms, armyworms, or grasshoppers. (See Baits.)

Azobenzene is a contact insecticide first prepared in 1832 but just now coming into practical use in greenhouses, particularly for red spider on roses, where it seems superior to other types of fumigation. It is purchased as a powder (Hypozene, Azofume 70, or Mite-y-Fume), mixed with a little water, and painted on steam pipes. One treatment lasts 2 to 9 weeks. There is some loss of color in rosebuds immediately after fumigation, but otherwise the treatment is relatively safe. Mite eggs are killed, syringing can be discontinued, and so black spot is no longer a problem.

Baits, Poison

Ant baits: best purchased ready prepared, but some formulae are given under **Ants** in the insect section.

Cutworm and Grasshopper Baits

A standard formula, made up in small quantity calls for:

1 tbsp. white arsenic, paris green, or sodium fluosilicate
2½ lbs. wheat bran

Thoroughly mix the above while dry. Then mix 1 cup molasses in 1 pint of water.

Add the molasses liquid slowly to the bran, stirring until it is moist, but not wet enough to squeeze out water. Some think a little ground orange or lemon adds to the attractiveness of this bait, but it is not necessary. Broadcast at night for cutworms; early morning for grasshoppers.

European Earwig Bait

6 lbs. wheat bran
½ lb. sodium fluosilicate
1 pint fish oil

Mole Cricket Baits

I	*or*	II
5 lbs. bran or corn meal 5 lbs. cottonseed meal ½ lb. calcium arsenate 2 qts. molasses solution (1–10)		1½ lbs. fresh earthworms in 2-inch pieces ½ oz. strychnine sulfate Mix and use within 6 hours

Slug and Snail Bait

1 lb. bran
2 tbsps. blackstrap molasses
1 oz. calcium arsenate
½ oz. metaldehyde
1 pint water

Sowbug Bait

I	*or*	II
1 part paris green 9 parts sugar (can substitute flour, corn meal, or middlings for half of sugar)		2 level tbsps. paris green 3 pints bran 1 cup fish meal

Weevil Bait

5 lbs. cull or low-grade raisins (or ground peelings and cores of pears or apples)
5 lbs. bran or shorts
½ lb. sodium fluosilicate

Practically all of these combinations or similar mixtures are available

under trade names: Acteen's Nails the Snail, Snarol, Snail-A-Tor, Slug-O, Bait-M Stop, Bug-Geta, Baito, Metameal, Go West, and many others.

Barium Fluosilicate—First used as an insecticide against Japanese beetles about 1936, and now sometimes used against potato flea beetles, Mexican bean beetles, and more especially for blister and spotted cucumber beetles; sold mostly under the name of Dutox. It is not compatible with nicotine, calcium arsenate, bordeaux mixture, soap solutions, or lime-sulfur.

Benzene Hexamine—See **Hexachlorocyclohexane.**

Bordeaux Mixture—Made by combining hydrated lime and copper sulfate in certain proportions. Its value as a fungicide was first noted in France about 1883 after the mixture had been applied to grapevines to prevent fruit being stolen. It is very often combined with insecticides and itself serves as a repellent for leafhoppers, flea beetles, and some other insects. It may be purchased as a ready-mixed dry powder, or may be made at home:

Mix 10½ tablespoons fresh hydrated lime in 1 gallon of water. Let stand at least ½ hour; then add to a solution of 7½ tablespoons monohydrated copper sulfate in 2 gallons of water.

Use the resulting mixture immediately, straining it into the tank through cheesecloth; throw away any left over and thoroughly rinse the sprayer. Because of the unsightly residue do not use bordeaux mixture on ornamentals unless absolutely necessary. On potatoes, where it is needed as a fungicide anyway, its repellent action is most efficiently utilized.

Borer Insecticides are of several types: materials to inject into burrows, such as nicotine paste (sold as Bor-Tox or Borerkil), or carbon bisulfide; or a repellent to be sprayed or painted on the tree trunk (Crystal Borer Repellent); or wax or some other emulsion (Dowax, Protex) to be sprayed on newly transplanted trees to prevent evaporation and keep the young trees growing too vigorously to allow borer attack; also paradichlorobenzene (PDB), or ethylene dichloride emulsion (E. D. E., Borecide) for treating the ground around peach trees.

Calcium Arsenate was first used extensively about 1919 for dusting cotton, and is still used for that purpose, often being applied by airplane. Production of calcium arsenate runs from seventy to ninety million pounds a year. It is not safe on fruits, and seldom has a place in the ornamental program; but it is frequently used on potatoes, beans, and other truck crops, being slightly cheaper than lead arsenate and containing somewhat more arsenic. In home gardens it is most often used as a dust, diluted with 3 parts of lime to 1 of arsenic. It can be safely used only on plants or parts of plants that are not eaten.

According to results just reported on several years' trials with beans

in Maine the effect of calcium arsenate on plants depends on whether the lime diluent has a high calcium or a high magnesium content. The former caused enough injury to decrease definitely the yield each year, while the latter increased the yield irrespective of insect control.

Calcium Cyanide (often purchased as Cyanogas) is a source of hydrocyanic acid for fumigation.

Calomel (mercurous chloride)—Used chiefly in control of cabbage and similar root maggots. Make a paste of ½ ounce of gum arabic, 1 to 2 ounces calomel, and a little water; then dilute with 5 gallons of water and pour around cabbage plants, or water rows of radishes, using 1 gallon to each 25 feet of row. Or dilute 1 part of calomel with 20 parts ground limestone, place in a coarse salt shaker and sprinkle a little around the base of each plant, so it enters the soil crevices. Or mix 1 part calomel with 3 parts cornstarch, and dust stems between top roots and lower leaves before plants are set. Calomel is not a deadly poison like *mercuric* chloride, which is also used for maggot control.

Carbon Bisulfide—A nearly colorless, vile-smelling liquid which is heavier than air and changes to a highly inflammable gas on exposure to air. It is used as a fumigant for pea and bean weevils and other stored grain pests, at the rate of 1 pound per 100 cubic feet of space; also in ant nests, and as a soil fumigant, injected into holes 18 inches apart; or, in the form of a commercially prepared emulsion, to flood the soil surfaces to control garden centipedes and some other pests; or, for rodent control, absorbed on a wad of cotton and pushed down into the burrow. A special machine, Demon Rodent Gun, is also available for saturating ground squirrel, prairie dog, or gopher burrows with carbon bisulfide. Remember it is *inflammable!*

Carbon Tetrachloride—A non-inflammable liquid, but of relatively low toxicity to insects. Mixed 1 part with 3 parts ethylene dichloride it gives a non-inflammable fumigant, sold as Chlorosol, for treating stored seeds and bulbs, and also for injecting into borer holes.

Chloropicrin, tear gas (sold as Larvacide)—particularly useful as a soil fumigant to kill nematodes, weed seeds, some fungi. It is non-inflammable, though decidedly irritating to the user. It can be purchased with special applicator and full instructions; should be used only in fallow soil at some distance from living plants. It is excellent for ridding the compost of weed seeds, and perhaps some hibernating insects, before the compost goes back to the garden.

Coal-tar Distillates—Complex materials containing carbolic acid and naphthalene, used in some dormant sprays to kill overwintering eggs, but otherwise toxic to plants.

Corn Earworm Oils—White mineral oil used alone or mixed with di-

chlorethyl ether, pyrethrum, or styrene bromide and purchased as Earwormicide, Corn Earworm Drops, and under similar labels.

Creosote Oils—Used for treating wood against termites; also, in the form of crude creosote, as a barrier against chinch bugs, poured on the soil in an inch-wide line on the brow of a plowed ridge; or as tarred felt paper strips soaked in creosote.

Crow Repellents—Crotox, Crow Bane, and other materials are available for treating seeds.

Cryolite (sodium fluoaluminate)—Brought from Greenland for the manufacture of aluminum, and for insecticides. This natural cryolite is often sold as Kryocide, but it is also made synthetically and distributed as Alorco Cryolite. It is not so toxic to humans as lead or calcium arsenate, but it is classed as a poison, with a legal tolerance of 0.05 grains residue per pound of fruit. It has been used extensively in the Northwest on apples with good results, but in the East climatic conditions make it of more doubtful value, as a fruit spray. In some states it is well liked for vegetables; in others it does not give as good results. In the South it is very widely used to control Mexican bean beetles, bean leaf beetles, cabbage worms, cucumber beetles, melon and pickleworms, tomato fruitworms, potato flea beetles, and pepper weevils. Used in mixed dusts for roses and other ornamentals it gives excellent control of diabrotica and blister beetles, and also has a good record for cranberry weevil and fruitworm, orange tortrix, strawberry leaf roller, and walnut husk fly.

Cryolite is inactivated by lime, hence should not be put on with bordeaux mixture or lime-sulfur. As a spray it is used at the rate of 1½ to 3 tablespoons per gallon of water; as a dust it is mixed with 1 to 2 parts talc, pyrophyllite, flour, or sulfur. Cryolite is not considered safe on peaches.

Cube, a source of **Rotenone,** which see.

Cutworm Baits—See **Baits.**

Cyanogas, calcium cyanide—See **Fumigation** in next chapter.

DD Mixture (1, 2-dichloropropane-1, 3-dichloropropylene)—A most promising new soil fumigant, giving excellent control of root-knot nematodes, wireworms, and some other soil insects, killing some weeds. It is not so unpleasant to use as chloropicrin but will burn if spilled on the skin and not removed immediately with soap and water. It has been used successfully on pineapple in Hawaii for several years, and in 1943 preliminary experiments were started in Mississippi. The results since then, on land for growing carrots, beans, beets, lettuce, eggplants, melons, potatoes, and tomatoes, justify the preliminary enthusiasm. It is applied at the rate of ⅓ ounce per hole, in holes 6 inches deep and staggered 18 inches apart; or, with a special applicator, in furrows 18 inches apart

at the rate of 200 pounds per acre for nematodes, slightly more for wireworms.

DD works best in sandy soil, and of course no plants are grown in the soil during treatment. Lettuce can be planted 5 days afterward, but a lapse of 10 to 15 days is advised for corn and cucumber. Increase in yields following treatment may be very great—3 tons of pineapples in untreated soil as against 17 tons per acre of DD treated soil; 3 to 21 tons with sugar beets. Preliminary experiments with an emulsion of DD to fumigate nursery stock also look promising.

DDT (1-trichloro-2, 2-bis [p-chlorophenyl] ethane, or, as often written, dichloro-diphenyl-trichlorethane), has probably received more publicity than any other insecticide yet produced. It is not new, having been synthesized in 1874 by a German chemist, but was not put to practical test as an insecticide until 1939 when its value against Colorado potato beetles was determined in Switzerland. It was brought to this country by the New York branch of the Swiss firm, Geigy Company, Inc., and supplied to the government for experimental work in 1942. Information on its control of lice and other man-menacing insects in the Army was first given to the public in 1943, and it was finally released for civilian use late in the summer of 1945. As manufactured by Geigy Company the name Gesarol designated DDT formulations for use on plants, and Neocid the material prepared for insects of man and animals. At the present time it is available under many different trade names, and in formulations containing varying amounts of DDT. In this case it is essential to read the label to discover the percentage of DDT and the use for which it is intended. Don't try fly and mosquito sprays on plants!

For plants, DDT is available as a powder, about 40 to 50 per cent DDT to be used at about 2 pounds per 100 gallons of water. The special dust mixtures vary from 3 to 10 per cent, depending on the insect to be controlled. Dusts apparently have a much shorter residual effect than the sprays.

For some insects, and on some plants, DDT has been so consistently successful and non-injurious that home gardeners should be able to use it profitably in the immediate future. On other plants and for other pests it must be considered still experimental. Apparently it is more or less injurious to the cucurbits. Tried on acorn squash it resulted in no squashes produced. In New Jersey experiments (in 1944), 5 applications on tomatoes gave a yield of 4 tons per acre *less* fruit than the tomatoes which had received no insecticide of any kind. When tried in California for control of thrips carrying spotted wilt, it produced a yellowing of leaves followed by a papery drying of tissue. On sweet corn it causes some reduction in size of ears.

DDT has little or no effect on Mexican bean beetles, and even seems to encourage European red mite, red spider, and other mites. It controls some aphids well, others not so well, but seems to require heavier dosages than for other pests.

DDT is very effective against leafhoppers. The control of these, together with flea beetles and Colorado potato beetles, has been very striking on potatoes. In fact, this is the first time leafhoppers have been controlled well enough to know how much injury they have been causing all these years. DDT sprayed plants are very much thriftier, not from any chemical action on the plant, but purely through stopping the devitalizing effect of the hoppers.

Economic effects may be far-reaching. If DDT increases the yield of potatoes from 40 to 140 bushels per acre, it will mean either that the price will go down with the market flooded, or less acreage will be planted. It also means that there is not much point in the home gardener growing potatoes in space better occupied by roses.

The homeowner apparently can make very effective use of DDT for the boxwood leaf miner, one application when the pupa is starting to turn dark taking the place of the many molasses and nicotine sprays which never did give more than fair results. DDT is more than promising for rose midge and for chinch bugs in lawns, and may be used for some shade-tree pests—gypsy moth, tent caterpillar, catalpa sphinx, sawflies, and spruce budworm.

DDT is apparently effective against cabbage worms, bean leafhoppers, carrot rust fly, eggplant lacebug, onion thrips, tarnished plant bug, spittle bug, and garden webworm. But where rotenone and other non-poisonous materials are satisfactory in controlling vegetable pests, DDT will not be so popular.

For fruits the toxicity of DDT to man will be less of a barrier, since it will be no more injurious than the standard treatments with lead arsenate now commonly practiced. However, because of its greater resistance to weathering, spraying with DDT must be discontinued some time before harvest. A tentative tolerance for DDT spray residues on fruit has been set at not more than 7 milligrams DDT per kilogram of fruit, but much more investigation is needed before a formal tolerance will be given.

On fruits DDT does a most excellent job of controlling codling moth, oriental fruit moth, and Japanese beetles. When used on peaches to control the fruit moth, it seems also to take care of peachtree borers. But whenever DDT is used in an orchard there is a tremendous build-up of European red mite, perhaps through killing the natural parasites and predators. In California an infestation of brown mite and two-spotted mite on almond was built up immediately when trees were sprayed with DDT.

It is effective against codling moths on walnuts and also kills walnut aphids, but since it also kills their natural enemies there soon are more aphids than where no spray is used. It is also effective, in California and other states, on grape leafhoppers, strawberry rootworm, grape berry moth, rose chafers, Fuller rose beetle, and California red scale on citrus.

There are some analogs, or chemical relatives, of DDT. One of them, Rhothane, is quite efficient against leafhoppers.

There is much still to be learned about DDT—its effect on the people who handle the spray, its effect on fish and birds and bees, on insect parasites and predators. Meanwhile it has served to awaken us to the value of our insect friends, to the value of insecticides in general, and to the specialized nature of insect control in the future.

Dichlorethyl Ether—Sometimes used in corn earworm oil, sometimes in an emulsion for control of sod webworm, or as a dormant soil treatment for plum curculio.

Diluents are the carrying materials in dust mixtures, sometimes entirely inert, sometimes having some insecticidal or fungicidal properties of their own. Hydrated lime, gypsum, bentonite, pyrophyllite, diatomaceous earth, fuller's earth, talc, kaolin, walnut-shell flour, sulfur, and others are typical diluents.

Dinitro Compounds—Derivatives of cresol and phenol, used in dormant apple sprays, chiefly to kill aphid eggs. Elgetol (trade name for sodium dinitro-o-cresolate) is also used to control euonymus scale. Dow Dormant is a dinitrophenol dormant spray.

For summer control of red spider and other pests the compound is dinitro-o-cyclohexylphenol, sometimes used as a spray but more often in dust form, under the name DN dusts, sometimes with walnut-shell flour as a diluent. DN dusts are also suitable for greenhouse use. Nitro Kleenup is a dinitro compound added to a dormant oil.

Dog Repellents are available under such descriptive names as Dawggone, Dogzix, Scram, Anti-Dog, Dog Check, and many others.

Dormant Oil Sprays—See **Oil Sprays.**

Ethylene Dichloride—Used with carbon tetrachloride for fumigation of seeds, bulbs, and sometimes for borers and (in emulsified form) to replace paradichlorobenzene in control of peachtree borers. The emulsion is effective over a wider range of temperature, but to avoid injury the dosages must be exactly according to manufacturer's directions.

Fish Oil, and **Fish oil Soaps**—Used as spreaders with insecticides and as contact sprays for aphids and other soft-bodied insects. See also **Oil Sprays.**

Fluorine Compounds—See **Cryolite, Barium Fluosilicate, Sodium Fluosilicate.**

Fumigants. See **Azobenzene, Calcium Cyanide, Carbon Bisulfide, Carbon Tetrachloride, Chloropicrin, Cyanogas, DD Mixture, Ethylene Dichloride, Hydrocyanic Acid, Methyl Bromide, Naphthalene, Nicotine, Paradichlorobenzene.** See also **Fumigation** in next chapter.

Geraniol—Used with eugenol as an attractant in Japanese beetle traps.

Hellebore, the ground rhizome of *Veratrum album,* has both contact and stomach poison properties. It is now used principally on currants and gooseberries for the currant worm.

Hexachlorocyclohexane (also known as **Benzene Hexachloride, Gammexane,** or **666**)—Another "new" and spectacular insecticide, first compounded in 1825, but with its insect-killing property only now being investigated, first in England and now here. Early reports are that it is very promising against pea aphid and potato aphid on tomato; and that it increases potato yields almost as much as DDT, is next to rotenone for Mexican bean beetles, very effective on striped and spotted cucumber beetles, apparently so against turnip and cabbage aphids and onion thrips, but not against leafhoppers.

Hydrocyanic Acid Gas (HCN) was originally used to protect insect collections in museums; then, in 1886, to kill cottony cushion scale on citrus trees in California, and later for nursery stock and greenhouse insects. The newest, simplest, and safest way to produce HCN is from calcium cyanide, commonly purchased as Cyanogas, which gives off its gas very slowly. It is used for citrus trees under tents, sometimes replacing the older dispensers of HCN gas from sodium cyanide. This type of fumigation is dangerous for use in greenhouses attached to dwellings, and it is too highly poisonous to be trusted to any but very responsible persons. See also Fumigation.

Japanese Beetle Sprays are based on rotenone; they are particularly good for grapes, peaches, and other fruit. Sold as Japellent, Jap-Ro-Cide, D-X Rotenone, and under other trade names. See also Rotenone.

Kerosene Emulsion is not very popular nowadays, for it is a lot of trouble to make it correctly, and it is injurious if not properly prepared. It is an effective contact insecticide in the greenhouse on crotons, palms, rubber plants, and other hardy stock, but it is not safe on succulent foliage of coleus, heliotrope, and begonia. It is best applied in late afternoon, with plants thoroughly syringed off with water the next morning.

STOCK EMULSION

2 gals. kerosene
½ lb. fish-oil soap, or laundry soap cut in pieces and dissolved in
1 gallon boiling water.

Add kerosene to the hot soap solution, slowly stirring constantly.

Put mixture in a hand-pump sprayer and force through the nozzle back into the container to get a creamy emulsion. If the kerosene separates out it is not safe to use. For a smaller quantity use 2 pints kerosene, 1 pint water, and 1 ounce soap. Commercial preparations of kerosene emulsion are also available.

For use on plants, dilute the *stock emulsion* as follows:

To get a 1 per cent mixture,	add 1 part stock to 65 parts water for aphids, and mealy bugs.
" " " 2 per cent	"	add 1 part stock to 33 parts water for white flies.
" " " 5 per cent	"	add 1 part stock to 12 parts water—use in soil for ants, and on some very tough plants for scales and red spider.

Lead Arsenate, our best-known stomach poison, is so widely used that it requires 50 million pounds a year to supply the demand. It has no value as a contact insecticide for sucking insects. Suggested for gypsy-moth control, in 1892, it was probably the first development by a chemist of a plant spray. It remains the standard for pests of shade trees, fruit trees, and ornamental shrubs and flowers, and has some use on vegetables.

Lead arsenate is sold in two forms. *Basic lead arsenate* is less toxic to insects but safer to foliage. It is mostly used in foggy areas of California and in eastern peach orchards. *Acid lead arsenate,* the standard form, is safe on most foliage at proper dilutions, but at high temperatures on some plants it causes burning. Brown spots (that resemble fungus spots) on cherry leaves are often arsenical injury, and sometimes rose leaves and other ornamentals have brown edges or tips. On peaches and other tender fruits lead arsenate is used at a low strength and mixed with an equal quantity of lime or, sometimes, with zinc sulfate. In the home garden *it should not be used on fruits* after they are well formed. Fruits grown commercially are machine-washed in dilute hydrochloric acid to keep the residue below the legal tolerance of .025 grains arsenious oxide and .05 grains lead per pound.

Usual dosages vary from 3 to 6 pounds per 100 gallons of water, which is ½ to 1 ounce per gallon; or 2⅔ to 6 tablespoons per gallon. For grub-proofing lawns the common dosage is 10 pounds per 1,000 square feet.

Lead arsenate is a virulent poison and should be kept in a safe place, far removed from food. The powder is often colored pink to denote its poisonous character.

Lead arsenate is convenient in dust mixtures, ordinarily 10 to 15 parts in 90 to 85 parts of a diluent—lime, talc, clay, or sulfur. When sulfur is used it becomes the famous Massey dust, good both for fungi and chewing insects on roses and other ornamentals. Lead arsenate may also be com-

bined with bordeaux mixture or other coppers, in spray or dust form, and is compatible with nicotine sulfate, often added as a contact poison. It must not be used with ordinary soaps, and its combination with dormant oils, tar, and dinitro compounds is questionable.

Lemon Oil, an aromatic compound safer than some other materials for tender greenhouse and house plants, is sold under that name.

Lime, Hydrated, is used as a diluent in dust mixtures, in the preparation of bordeaux mixture, and as a safener for arsenical sprays, as it prevents or neutralizes the formation of arsenic acid on sensitive foliage. Depending on its source, lime has either a high-magnesium or a high-calcium content. Combined with calcium arsenate, high-magnesium lime has recently been found to increase potato yields, while high-calcium lime decreases the yield. Yet in my tests with the new fungicide, Dithane, high-calcium lime proved most satisfactory.

Because of its alkaline nature, lime should not be used with cryolite or other fluosilicates, nor with pyrethrum, rotenone, or DDT, or on foliage which has been treated with Black Leaf 155, for it will release free nicotine and so cause injury. It is, however, the best diluent for nicotine dusts because it does release nicotine fumes for action against sucking insects. Lime is also used as a deterrent for slugs.

Lime-Sulfur is a fungicide also used as a contact insecticide, valuable chiefly as a dormant spray but sometimes good at summer strength for red spider and other mites. It was first used as a sheep dip, then for San Jose scale in California, in 1886, and about 1900 was introduced in the eastern states. It is sold in liquid and dry form, the former preferable because it is more stable.

The liquid is used at a 7 to 8 or 9 dilution, for a dormant spray applied in spring *before growth starts,* to control scale insects; and at a dilution of 1 to 40 or 50 during the growing season. It is unpleasant to use, will stain paint, and is being replaced by oil sprays. Personally I use lime-sulfur in preference to oil for juniper and rose scales wherever it is possible to keep the spray drift from reaching near-by buildings. Lime-sulfur should not be mixed with fluosilicates, rotenone, or pyrethrum, or fixed nicotine; but it is compatible with nicotine sulfate. When combined with lead arsenate in fruit-spray schedules, directions for each region should be carefully followed.

London Purple, one of the oldest arsenical poisons, is a waste product of the dye industry. When treated with lime it turns purple. Its arsenical content was always uncertain, and it is now almost obsolete as an insecticide, replaced by lead and calcium arsenates.

Magnesium Arsenate is much newer than the other arsenicals, being patented in 1922. It is not safe on fruit trees, but is safer than lead

arsenate on bean leaves, hence has a certain limited use in control of Mexican bean beetles. Since it should not be used after pods have started to form, it is not so popular in home gardens as rotenone.

Mercuric Chloride (also known as **Corrosive Sublimate** or **Bichloride of Mercury**) is a deadly poison much used as a disinfectant, at a 1 to 1,000 dilution (one 7-grain tablet to a pint of water, or 1 ounce of the powder to 8 gallons). It can be poured on the soil around cabbage and broccoli plants for control of root maggots; but mercurous chloride (calomel) is safer in the home garden. Mercuric chloride will kill earthworms in lawns, can be used for soaking gladiolus corms to kill thrips, or for treating iris rhizomes to prevent rot following borer attack.

Mercurous Chloride—See **Calomel.**

Metaldehyde is the principal ingredient in the newer baits for slugs and snails, seeming to attract them and then killing on contact. It is often mixed with calcium arsenate and is available in convenient pellet form as well as a dry mix. Sold under such trade names as Bug-Geta pellets, Bait-M-Stop, Slug-O, Arione, Snarol.

Methyl Bromide is a fumigant, originally used as a fire-extinguisher liquid, then for fumigation of dried fruit, and lately finding increasing importance in fumigation of balled or potted nursery stock and in making aerosol sprays. Treatments of nursery stock are made in special fumigation chambers. They keep the California consumer from getting tea scale and other pests along with camellias ordered from southern states, and protect the southern gardener against getting Japanese beetle grubs in stock ordered from the East.

Methyl bromide is also used to kill potato tuberworms in carloads or warehouses, is helpful in killing bulb mites in lily bulbs, narcissus flies, oriental fruit moth in dormant nursery stock, and in many other ways.

Mole Baits are sold under many names: Mole-Nots, Mo Lo, Mologen, et cetera.

Mowrah Meal, available commercially under that name for control of earthworms in lawns, is made from ground seeds of the madhucca tree of the East Indies. Dosage is 15 pounds per 1,000 square feet. It is comparatively non-poisonous to man, deteriorates with age, must be kept dry.

Naphthalene is sold as flakes and as moth balls. The latter have a value as rabbit repellents, and some recommend placing a moth ball in soil of a potted plant to control cyclamen mite. The most popular garden use of flakes is in treatment of gladiolus corms for thrips, at the rate of 1 ounce per 100 corms, for not more than 3 or 4 weeks.

Flakes are used in the Northwest for carrot rust fly, 1½ pounds scattered along 100 feet of row. They are also vaporized in greenhouses to kill red spiders and thrips. A soap and naphthalene mixture is recommended

as a borer repellent, but such combinations may be unsafe in unskilled hands.

Nicotine, surely the gardener's friend in many ways, is of first importance as a contact poison, in the familiar nicotine-sulfate spray sold as Black Leaf 40, and used in Wilson's O. K. Plant Spray, Nico-Tox, Aphido, D-X Nicotine, N. Z. F., Botano—N Spray, and others. Nicotine, an alkaloid in the tobacco plant, is obtained from wastes of cigar and cigarette manufacture, the standard nicotine-sulfate solution containing 40 per cent nicotine. For aphids and other soft-bodied insects the usual dilution is 1 to 800, or 1 teaspoon per gallon, or 1 pint to 100 gallons. It may, however, be used at a 1 to 1,000, or even weaker dilution, and at 1 to 400 (2 teaspoons per gallon) for hard-to-kill insects. Soap increases the spreading and wetting qualities and also helps liberate the nicotine. Although nicotine sulfate is a deadly poison there is little residual effect and any residue can be readily washed off. Hence it can be safely applied almost up to harvesting time.

Nicotine dusts usually have lime as a diluent, and 3 to 4 per cent nicotine.

Free nicotine, containing 40 to 50 per cent or more of nicotine, is sold in a form much more volatile than nicotine sulfate; it is sometimes used as a contact poison outdoors, but more often for greenhouse work or for manufacturing dusts. As a liquid fumigant free nicotine is painted on steampipes in greenhouses, or vaporized on hot plates, or impregnated into porous papers for burning, such as Vapo Fume, Nico-Fume.

A recent use of nicotine is as a stomach poison in nonvolatile compounds like nicotine tannate, nicotine bentonite, and other "fixed" nicotine compounds (Black Leaf 155) for the control of such pests as codling moth and grape berry moth. Fixed nicotine compounds must not be used with lime, which "unfixes" them.

Oil Sprays can be animal or vegetable oils (such as fish oil, lemon oil, coconut oil), but more often in speaking of them we mean petroleum oils in the form of miscible oils, oil emulsions, or emulsifiable oils.

In an *emulsion* the oil is broken up into fine globules in water, which varies in amount so that the product is a thin cream or a thick paste. Most dormant-oil emulsions are made from red engine oil or pale lubricating oil, with the oil kept suspended by an emulsifier which is chemically active (soap, sulfated alcohol, sulphonated oils, organic acids, or vegetable oils), or chemically inactive (soybean flour, calcium, or ammonium caseinate).

Oil emulsions are made with a minimum of water and are diluted at the time of spraying. The percentage of oil in the emulsion is stated on the label, and the percentage of oil desired in a dormant spray is given

in spray schedules for different localities. To calculate the dilution properly *multiply the gallons of spray required by the per cent of oil desired, and divide by the per cent of oil in the stock emulsion.* Example: to make 50 gallons of a 3 per cent oil spray from a 90 per cent oil stock—50 × 3 divided by 90 gives 1⅔ gallons stock emulsion, to which you add 48⅓ gallons water.

Trade-marked oil emulsions include Emo, Kleenup, Oil Emulsion 83, Oil Tone Dormant, Ortazol, Dormo, Emulso, and Spra-Cream.

Emulsions which contain a high percentage of cresylic acid, a coal-tar derivative, are called tar emulsions and are used particularly for scales—Ortho, Straitar.

Miscible oils are those most used in home gardens. They are manufactured from lubricating oils, are transparent, contain 93 to 99 per cent oil, with an emulsifier dissolved in the oil, are somewhat more stable than oil emulsions, and have too little water to freeze when stored. When water is added they turn the creamy white color of an emulsion. Familiar trade names for miscible oils include Scale-O, Scalecide, Scale-Oil, Dormasol, Sunoco, Dow Spray Dormant, and Dendrol. Manufacturer's directions must be followed, but normally a dilution of 1 part to 16 of water is used for deciduous trees and 1 to 25 or 30 for evergreens.

Emulsifiable oils are much like miscible oils but emulsify to the white color only under pressure as the material leaves the sprayer.

There are many precautions for dormant-oil spraying on fruit or shade trees or ornamental shrubs:

1. Do not use an oil spray when the temperature is below 45° F. or likely to drop below freezing during the following night.

2. Spray early enough in the day so that the spray can dry before night.

3. Spray preferably in early spring rather than fall or winter, and as close as possible to the time buds are ready to burst.

4. Do not spray after buds break and show leaves more than ¼ inch long.

5. Do not use lime-sulfur with oils; allow at least 1-week interval, better longer, between application of oil and lime-sulfur; and 2- to 4-week intervals between oils and other sulfur sprays or dusts.

6. Do not use oil sprays on sugar or Japanese maples, on Japanese or black walnut, on butternut, beech, or magnolia.

7. Never repeat a dormant spray the same season; do not "drench" trees with spray.

8. Make sure that all other spray residues are flushed out of spray tank before putting in oils. If doubtful, clean with trisodium phosphate.

Summer white oils are lighter oils, safe, at proper dilutions, for *summer* sprays on fruit trees and to control scales, mealybugs, whiteflies on ornamentals in greenhouses or outside.

Manufacturer's directions for particular plants should be carefully followed. Do not spray when the temperature is above 85° F., or during the hottest part of the day, when plants are in bright sun. Greenhouse and house plants should be moved out of the sun for treatment, and should be washed off with water a few hours afterward. Summer oils include Volck, our old stand-by, Orthol-K emulsion, Greenol, Ready Mix, Verdol Summer Spray Oil, Nico Sol Summer Spray Oil, Exelol, Superla Summer Oil, DuPont Summer Spray Oil. Summer oils have nicotine combined with them or may be used with nicotine, *but never with sulfur.*

Paradichlorobenzene, or **PDB,** similar to naphthalene but more volatile, sold as Paracide, Paradow, Parapont, Di-Chloricide, and under similar labels. It is used principally as a soil fumigant in the control of peachtree borer, being scattered in a ring around the base of trunk in fall and the fumes confined with earth. The dosage must be exact. See Peachtree Borer.

Paris Green—A stomach poison first used as a paint pigment, and tried for Colorado potato beetles as early as 1865, when it was applied to the vines with a broom. Later it was tried for cankerworms and codling moth. It is a complex salt containing both copper and arsenic, is coarser and more soluble than other arsenicals, and nowadays is seldom used except in grasshopper and cutworm baits and as a mosquito larvacide. For some years it was recommended with sugar as a poison bait spray for gladiolus thrips, but there was some foliage injury, and it has been largely supplanted by tartar emetic.

Phenothiazine—Promising as a plant spray a year or two ago, but at present used chiefly, and very effectively, to control some insects of farm animals.

Pyrethrum—One of the earliest insecticides, possibly first used by Caucasian tribesmen. Pyrethrum is a plant, one of the chrysanthemums, and the use of flower heads for insecticidal purposes is said to have originated in Persia, whence it was introduced into Europe early in the nineteenth century, coming to the United States by 1855. It was sold often as Persian Insect Powder, or Dalmatian Insect Powder. Most of the pyrethrum coming into this country has been extracted for household sprays, about 2,000 brands being on the market prior to Pearl Harbor. Before World War II Japan, Yugoslavia, Kenya, and Italy were the largest pyrethrum-producing countries, but during the war Kenya Colony in East Africa was the chief source of supply, with a small amount coming in from South America. During the war practically all pyrethrum imported was sent out again to the armed forces, much of it in aerosol bombs.

The active chemical principles, found in the ovaries and achenes of the flowers, are known as pyrethrins I and II, and extracts purchased under trade names should state total pyrethrins content.

Pyrethrum is primarily a contact insecticide, killing not only through the inhaling or absorbing of dust or spray fumes through the insect spiracles, or breathing pores, but also by actual contact with the insect body, and by paralyzing the nerve ganglia. If taken internally by chewing insects, pyrethrum also acts as a stomach poison. Since it is relatively non-poisonous to man and warm-blooded animals it is especially suitable for use on edible crops; and since it leaves no unsightly residue it is often desirable for ornamentals.

Pyrethrum gives a quick kill, or at least a paralysis, particularly at high temperatures, but the residual effect is low. Rotenone works much more slowly, but is effective for a longer period and at lower temperatures. Frequently the two are combined, as in Pyrote, Pyrocide, Pyrotex. Other pyrethrum compounds include Evergreen, Black Arrow, Special Red Arrow, Krop-Saver, Botano—Py, Seagreen, Awinc, Spra-Tox, D-X Pyrethrum, Smack, and many, many more.

Most pyrethrum sprays have soaps or other wetting agents and are very concentrated. When diluted with water they are decomposed rapidly in the alkaline-soap solutions to inert compounds. Always use a pyrethrum spray *immediately* after diluting it to proper strength.

Pyrethrum is not compatible with lime, calcium arsenate, zinc arsenite, or paris green. Special dust mixtures are impregnated with pyrethrins in oil and have much less breakdown. Special oil sprays have pyrethrins incorporated.

Pyrophyllite—A hydrated aluminum silicate very similar to talc in its properties and used as a diluent in various dust mixtures, often seeming to increase the toxicity of the insecticide. It can be used where lime is undesirable.

Red Squill—The ground bulb of a subtropical plant of the lily family, used as a rat and ant poison; not harmful to humans and pets.

Rotenone—A contact insecticide and a stomach poison, and probably the gardener's best chemical friend. It is the principal toxic constituent in certain leguminous plants (derris, cube, timbo—of the genera *Derris, Lonchocarpus, Mundulea, Tephrosia*) which when broken up and thrown into tropical streams, provide the natives with fish. Although deadly to cold-blooded animals, killing goldfish in garden pools as readily as food fish in a stream, rotenone is relatively harmless to humans, dogs, cats, and other warm-blooded animals.

It was about 1920 before rotenone came into much notice as an insecticide, and its great popularity began in the early 1930s. By 1939 more than a million pounds of cube and derris roots were being imported annually, much of it from British Malaya, Netherlands East Indies, the Philippines, and other Eastern countries, and some lonchocarpus roots

from Brazil, Peru, and Venezuela. Since the war most importations have come from South America.

Plant roots vary in rotenone content from 1 to 11 per cent, but they are ground and blended by manufacturers to a uniform 4 or 5 per cent. This ground powder is then mixed with talc, sulfur, pyrophyllite, or other diluent until the final rotenone strength is 3/4 to 1 per cent. The wartime strength of 1/2 per cent was not very effective.

For spraying, rotenone is provided in a liquid extract containing also deguelin and other materials with some value as insecticides. Such extracts are usually labeled as to rotenone content and total extractives.

Rotenone apparently paralyzes the respiratory system as well as acting as a true stomach poison. It gives a slow kill, sometimes taking as much as 48 hours, but it is surer than pyrethrum, particularly in cool weather, and the residue remains effective for nearly a week. Do not use rotenone with lime, copper-lime dust, or bordeaux mixture, and if the diluent is sulfur do not use it on cucumbers and melons.

Trade names for rotenone products are legion: Red Arrow, Rotofume, D-X Rotenone, Garden Guard, Cream of Agicide, Rotecide, Derispray, NNOR, Cubor, Sulrote, Deridust, Tri-Tox-Cide, for a few samples. For Japanese-beetle control rotenone is combined with rosin residue or similar material to strengthen the adhesiveness and residual effect, but even these compounds, like Jap-Ro-Cide and Japellent, lose their effectiveness after a week.

Ryanex—A very new and rather promising plant insecticide prepared from tropical plants of the genus *Ryania speciosa.* In early experiments it gives better control of the European corn borer than rotenone, and is toxic to oriental fruit moth on quince without injurious plant effects.

Sabadilla—Another exciting "new" insecticide, but one used for years to get rid of lice on cattle. It is the toxic ingredient in sabadilla seed, chiefly from a lily family plant from Venezuela, *Schoenocaulon officinale,* but obtainable from about 20 plant species grown in South, Central, and North America. In 1943 standardized dusts prepared at the University of Wisconsin were found effective against squash bugs, potato and bean leafhoppers, cranberry insects, cabbage worms, and plant bugs on alfalfa. Tests since then have shown rather amazing results with hard-to-kill insects in the Hemiptera or half-winged group, particularly lawn chinch bugs, harlequin bugs, and tarnished plant bugs, as well as squash bugs. It is sold as Sabacide, and is the active ingredient in Chinch-O and probably in other chinch-bug dusts.

Salp (sodium antimony lactophenolate)—Coming into use as a substitute for tartar emetic in control of thrips on gladiolus and perhaps roses, and for leaf rollers. It is said by the manufacturer to be more effective

than tartar emetic at temperatures above 60° F. It is combined with sugar in about the same way as is tartar emetic, but the amount of sugar can be reduced with flour. Use at the rate of 4 tablespoons Salp, 2 each of sugar and flour, to 3 gallons of water. The sprayer must be thoroughly cleansed of all traces of other chemicals.

Soaps—Used as spreaders to break the surface tension between the spray droplet and the waxy surface of plant foliage and so ensure the wetting of the whole leaf. Soap is added to Black Leaf 40 at time of use, but many proprietary compounds already contain soap. If you expect to do much spraying, it is a lot easier to have a liquid insecticide soap on hand, which can be measured by tablespoons or in a measuring cup marked off in fluid ounces, and can be used in cold water. Ordinary bar soap, or flakes, have to be dissolved in warm water in the house and then taken to the garden.

The general rule is 1 ounce of soap, or 1 cubic inch of flakes, to a gallon of spray. Soap is itself fairly efficient as an insecticide, particularly for aphids on house ivies and similar pests. *Soap should not be used with lead or calcium arsenate or with fluosilicates, with lime-sulfur or with lime.* A very special type of soap is needed to go with fixed nicotine, wettable sulfur, bordeaux mixture, fixed coppers, and oil sprays.

Sodium Arsenite—A very soluble and poisonous compound used in ant syrups, and occasionally in poison baits.

Sodium Fluoaluminate—See **Cryolite.**

Sodium Fluoride—Sometimes used in place of white arsenic in baits, but chiefly for roaches, ants, and other house pests.

Sodium Fluosilicate—Replaces sodium arsenite in grasshopper, cricket, and cutworm baits.

Sodium Selenate—Another new wonder-worker. Applied to the soil, it is taken up into plants which are thereby made poisonous to red spiders, chrysanthemum midge, and leaf nematodes. But sodium selenate is not yet for the amateur gardener because of the danger of building up a residue in the soil that for edible plants might prove dangerous; it is, so far, for the professional florist, who has learned how to treat his soil with very great exactness. It takes only ¼ gram per square foot of bench soil, applied with the right amount of water, and one treatment will last 3 to 6 months. Having seen the healthy carnations in Cornell greenhouses treated with selenate and those left untreated completely infested with red spiders, I can only hope that someday there will be foolproof ways to use it outdoors. It must never be used on vegetables, or on land where vegetables are to be grown within a year, for the poison is taken up from the soil long after treatment.

Spreaders, Stickers, Wetting Agents, Deposit Builders—A miscel-

laneous class of materials aimed at improving the performance of the chosen insecticide. Before a liquid can spread and cover a plant surface easily it must wet that surface, so wetting agents are those which reduce the surface tension. Soap is one of the oldest and best wetting and spreading agents. Casein or skimmed-milk preparations, and flour, act as spreading, wetting, and adhesive agents in spray mixtures. Many proprietary compounds are on the market—Vatsol, Mixol, Spra-Catalizer, Filmfast, DuPont Spreader Sticker, Triton B-1956—a synthetic-resin type emulsifier, spreader, and deposit builder coming into rather wide use. In using B-1956 with a fungicide on hard-to-wet azalea petals recently I found that it markedly reduced the unsightly effect of lime used to safen the fungicide. Many spray concentrates purchased under brand names have the wetting and spreading agents already incorporated.

Sulfur—Thought of principally as a fungicide, or as a diluent in insecticidal dusts, but itself an important contact poison, both as straight sulfur and as lime-sulfur. The Greeks had a word for it, "Theion"; the Romans named it sulfur; Homer mentions it as a disinfectant.

In dust form, ground so small it will pass through a 325-mesh sieve, it is good for the control of red spider, broad mites and some other mites, sometimes for newly hatched scale insects, and as a stomach poison for young caterpillars. It is also used in combination with rotenone, cryolite, and other insecticides where an alkaline ingredient, such as lime, would be harmful.

Wettable and flotation sulfurs are available for spray mixtures.

Sulfur is not compatible with oils, and should not be used on plants which have recently been treated with oil, should not be used with most soaps, nor on squashes, melons, or other members of the cucurbit family. Used when the temperature is high (above 80° F.), sulfur may burn the foliage on any plant.

Tanglefoot is a sticky material applied around trees and shrubs to prevent certain insects from climbing up to feed or lay eggs; used against cankerworms, climbing cutworms, Fuller's rose beetle, ants, and some other insects. Tanglefoot should always be applied on a band of paper or balsam wool. Shade trees have been very seriously injured when the bark was scraped and tanglefoot applied directly.

Tartar Emetic (potassium antimonyl tartrate) is used with brown sugar, honey, sorghum, or corn syrup to control thrips on gladiolus, roses, onions, and citrus fruits. Although varying amounts have been recommended, the present standard is 2 pounds tartar emetic, 4 pounds brown sugar (or 5½ pounds sorghum or 5 pounds honey) to 100 gallons of water. The equivalent in small quantities is 1 ounce tartar emetic, 2 ounces sugar, to 3 gallons of water; or 2 teaspoons of the poison and 4 teaspoons of sugar

to 1 gallon. The spray should be applied as a fine mist, so that small droplets of baited poison cover the foliage or flowers. Tartar emetic must not be used with lime, lime-sulfur, copper or zinc compounds, but it is compatible with nicotine sulfate. Thoroughly clean the sprayer before use.

Thallium Sulfate is used principally in ant baits and in poisoning seeds for control of mice, rats, ground squirrels, and the like. *This compound is exceedingly poisonous to man,* and baits containing it should never be mixed at home. In California the possession of thallium sulfate by the general public is forbidden by law.

Thiocyanates—Synthetic organic chemicals which have been developed for contact fly sprays and for other household pests, and now of increasing importance for horticultural use. They have been tested for some years in greenhouses against aphids, whiteflies, thrips, mealybugs, and spider mites; they helped make reduced rotenone sprays and dusts more potent during the war, and now have some place outdoors on vegetables and ornamentals. Follow manufacturer's directions for use on specific insects and plants with Loro, Lethane 60 (for use with rotenone), Lethane B-71 (dust), Lethane B-72 (spray).

Tobacco Dusts—Finely ground tobacco mixed with suitable diluent, sometimes used in ground treatments for chinch bug and soil aphids, but not so potent as nicotine dust prepared with the extract.

Trisodium Phosphate—Excellent for cleaning deposits out of spray tank and flushing through the hose. Use at 1 pound to 30 gallons; or about 1 ounce to 2 gallons. This is carried by hardware stores, chiefly for painters.

Wax Emulsions—For spraying newly transplanted trees and other nursery stock to prevent too rapid evaporation and borer injury—Dowax, No-Dri.

Yamtox—Trade name for a product made from the yam bean, grown in Mexico and South America. It is used in greenhouses for control of bean, chrysanthemum, and green peach aphids, for onion and greenhouse thrips, for red spiders; it also seems to have some value against Mexican bean beetles outdoors.

Combination Sprays and Dusts—In the small garden it often saves time, and sometimes expense, to apply fungicides and insecticides in combination. Pomo Green, Pomo Green with Nicotine, Triogen, Scientific Rose Spray, 3-Way Dust, Tennessee Triple Peach Spray or Dust, Sulrote, Protexall, and other combinations answer this need. Their value in your particular garden must be determined by trial and error. Ordinarily it is possible to make out a spray or dust program using a combination treatment for a number of pests and diseases, and then an occasional special treatment for a resistant insect, or for some plant which is subject to injury by the combination.

Chapter III

SPRAYING, DUSTING, FUMIGATION

THE ART OF SPRAYING

SPRAYING IS A FINE ART, AND ONE WHICH ALL TOO FEW GARDENERS ever acquire. It takes a lot of common sense and a modicum of brains; it takes a sense of timing, and a sense of responsibility for your plants. It takes a little mechanical skill, but not necessarily too much brawn, for now that the war is over you may be able to hire that. To turn a spraying schedule over to a handyman gardener is fatal—to the plants, not the bugs—but to use the handyman gardener to supply power while you do the actual spraying—well, that's different. At least it ought to be, although experience makes me rather skeptical.

For the past fifteen years I have been telling, and showing, New Jersey gardeners how to control black spot on roses. They think it sounds like a lot of work and get me to do it for them. I start in the gardens about the first of April, prune the roses properly, give them a dose of lime-sulfur, dormant strength, and then about the first day of May start weekly summer spraying, keeping it up until late October. The roses stay healthy, and there is not only a good June display, but gorgeous fall bloom, often continuing, even here in the North, up to Thanksgiving.

After 2 or 3 years some clients feel this is a rather expensive way to get roses and think they should be able to carry on by themselves. I agree most heartily, and start them off with explicit instructions. My telephone rings about three autumns later and one side of the conversation goes something like this:

"What's the matter with my roses? They've looked awful for the last three years. I haven't got any fall bloom; the bushes haven't any leaves. I've got a good gardener, he sprays regularly . . . What? Did he start early in the spring? Well, of course we were pretty busy with other things in May . . . Did he spray every week? Why, yes, except when it rained

the day he was due . . . Did I use Triogen like you said? Certainly, we had some left over from last year. We ran out of the number-one spray, and I didn't want to buy a whole new kit, but the man at the seed store told us how to mix up something just as good . . . Did the gardener clean the sprayer every time he finished spraying and make up a fresh mixture the next week? Well, naturally, if we had a lot left over we couldn't afford to waste it. I guess it wasn't a very good sprayer—it didn't work too well after a while . . . Did we keep on spraying all fall? Why, no; why should we, when the beetles were all gone? Can't you come over and give them a treatment so they'll be all right next year?"

I solemnly swear this is a true word-for-word report of what the last telephone caller said, and it is typical of dozens. I did leave out one point—it sounded too incredible for you to believe, but here it is: that excellent gardener who knew just how to deal with pests took all the soil off the rose roots in the spring and sprayed them with something to prevent black spot. It worries me a little to think how gullible garden owners are, how likely to entrust their cherished plants to anyone and to any kind of treatment in the name of disease and pest control. For that former client of mine is a good gardener, and a conscientious one, and the man who works for her really has a green thumb. But when it comes to spraying, common sense somehow gets left out of the picture.

I find that many of you, good gardeners otherwise, are very apt to listen to so-called "tree experts" who come to your door and want to spray your maple with lead arsenate to control aphids dropping honeydew; or put something on the soil to take care of insects chewing the foliage; or spray your boxwood for leaf miner weeks after the flies have finished laying their eggs. In this manual there is a good deal of stress on tree pests, not because I expect you will do your own tree spraying, but so that you may obtain adequate care for your trees, may choose between the quack who may kill them and the reputable outfit which will give you your money's worth and—what is more—will be quite honest in saying you cannot afford to treat some trees for certain pests, and that you cannot afford *not* to treat others.

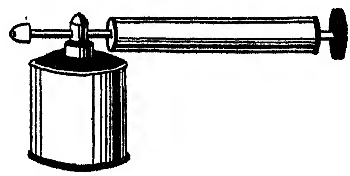
Some states now certify tree experts, some states require a license for certain types of spraying or fumigation; but at the moment there is no uniform way to be assured of good service except to choose an established firm of good reputation in your neighborhood. Most such concerns are members of the National Shade Tree Conference, and this is one mark of good standing in that field. The membership list, incidentally, is given in *Entoma*, separated into six regional groups—New England, Eastern, Southern, Central, Midwestern, and Western. There is a good deal of talk now on educational and professional standards for arborists, and I

have recently been on a committee to help formulate these. It seems to me equally important that homeowners and the gardening public should be educated as to what they can and should expect from these arborists.

Choosing a Sprayer

There are 4 or 5 types of sprayers commonly used in a home garden—the atomizer, the compressed air, the knapsack, occasionally the bucket pump, and the wheelbarrow; and, for large estates, the barrel sprayer (in essence a larger wheelbarrow), and the power sprayer with a capacity of 100 gallons or more and generating 300 to 500 pounds pressure.

Figure 2



Small atomizer type sprayer

The Atomizer-Type Sprayer works something like a flit gun, averages 1 quart in capacity, and is made of tin, galvanized iron, brass, or copper, or may be equipped with a detachable glass jar. The extra expense of brass or copper is repaid with longer life (if you clean the sprayer after use). Pushing the plunger back and forth to get pressure is much harder than it looks, and after you have sprayed 2 or 3 rosebushes you are ready to quit. Such a sprayer is fine for house plants, and for a *very* few plants outside. It is most effective when you are after aphids on buds and new shoots and can spray directly at them. Getting adequate coverage of undersurfaces is difficult. (Figure 2.)

The Compressed-air Sprayer of 2, 3, or 4 gallons' capacity is designed to be pumped up, slung over one shoulder, operated as long as the pressure lasts, then set down, pumped up again, and so on, as long as your breath holds out to pump. Mine doesn't last very long. In this sprayer the air pump is clamped tightly into an air-tight tank filled about two thirds full of solution. The air pumped into the space between the solution and the top of the tank provides the pressure. (Figure 3.)

The compressed-air sprayer is an advance over the atomizer. It usually has a spray rod with a curved or swivel nozzle which will let the spray reach undersurfaces, and 2 or 3 gallons will treat many more plants than a quart. It is hard to clean; the pressure varies widely; it sprays only a short distance from the nozzle, and it is heavy to carry and pump. It is,

however, the type most commonly found in home gardens, and with a copper tank, kept properly cleansed, should last several seasons.

Figure 3

Compressed-air sprayer; about 3 gallons capacity

The Bucket Pump is designed to be clamped to a 2- to 4-gallon bucket, pumped with one hand while the other operates the spray rod. Such apparatus is easy to clean, but of limited capacity, and requires constant pumping. (Figure 4.)

The Knapsack Sprayer is worn on the back. It looks heavy, and it is, when filled with 2 or 3 gallons of spray mixture; but once it is swung off the ground the weight is carried by both shoulders. It is much easier for a prolonged spraying job than the compressed-air sprayer, and I speak from experience as a woman who has done a lot of her own spraying with both types. The pressure is continuous, maintained by an effortless moving up and down of a lever on the right side of the operator, while the left hand is free to hold the spray rod, which will send spray to the tops of fairly tall bushes and underneath the lowest ones. If you want to make up a different type of mixture you don't have to spray out all the solution to release the pressure. The tank can be opened immediately, rinsed, and the new liquid substituted. Such a sprayer costs at least twice as much as the compressed-air type, and it is just as difficult to clean, but it is a lot easier on your disposition, and well worth the difference in price. (Figures 4 and 7.)

Wheelbarrow Sprayers don't have to be literally wheelbarrows, but they are tanks, usually of galvanized iron, which can be mounted on a 1- or 2-wheeled truck and so readily moved about the garden. My own opinion is that if you can only have one sprayer, this is the type to buy. It will take care of anything from one or two roses up to a good-sized border of shrubs, or even small fruit and shade trees. (Figures 4 and 7.)

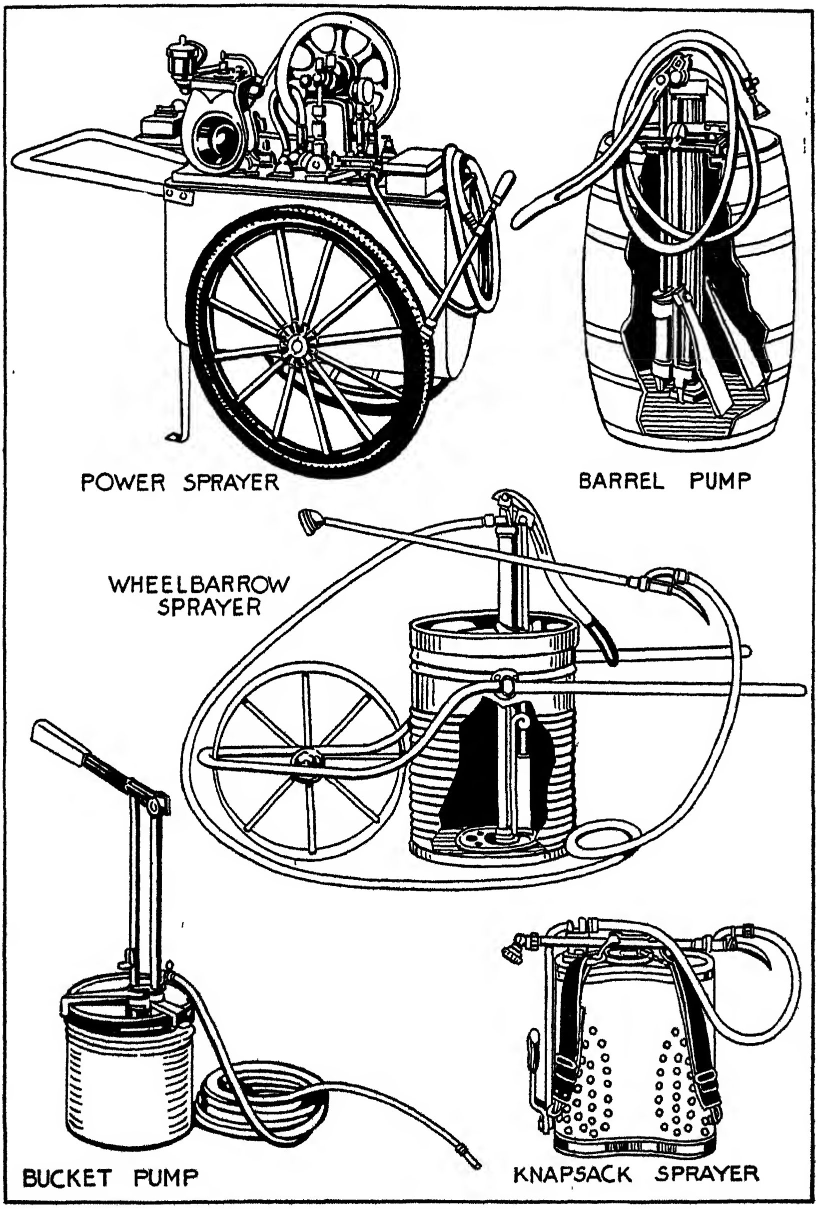


Figure 4 *Different types of sprayers*

Pressure is maintained and the mixture is agitated by pushing a handle up and down. Here is where that handyman gardener comes in (or maybe your husband). He does the pumping and pushes the heavy truck

around while you concentrate on handling the spray rod, which comes in 3 sections. For trees, all 3 sections are put together; for most spraying around the garden 2 sections are best, and they cover a lot of ground in a short space of time. A wheelbarrow sprayer will finish up the job in a half or even a third of the time required by a knapsack sprayer, and about a quarter of the time it would take to go over two or three hundred roses with a compressed-air sprayer.

The wheelbarrow sprayer I use myself is the Paragon type, a 12-gallon tank with a 2-wheel detachable truck. Tucked away in the back of my Ford coupé it has traveled all over the country. One sprayer lasts for years because separate parts for replacement are readily available. A 10-foot hose comes with the sprayer, but I usually have this replaced with a 25-foot length of heavy-duty spray hose, to reach easily all sides of thick clumps of shrubbery, and to get into borders where it is impossible to take the truck.

This type of sprayer is easily cleaned and costs little more than the knapsack sprayer. By enabling you to get so much more done in so much less time, it encourages you to keep to a spray schedule. It is also possible to buy wheelbarrow sprayers of 15- to 20-gallons' capacity operated with electric or gasoline pumps.

Going up in capacity and pressure there are barrel sprayers, and then power sprayers with a maximum load of 800 gallons, with pressure ranging from 200 to 1,000 pounds, and discharging from 2 to 80 gallons a minute. But those are for professionals. You may see one for a brief half-hour when it is used on your elms or oaks, but you will probably not be buying one.

Other Equipment

To go with the sprayer, assemble in one corner of the garage or garden house the tools and miscellaneous items illustrated in Figure 5.

1. A 10- to 12-quart pail (bucket to you southern gardeners), or preferably two, and of enamel if possible.
2. A set of measuring spoons (these are gay plastic affairs nowadays).
3. A measuring cup, marked in fluid ounces, as well as ¼ cup, et cetera.
4. A quart jar for measuring, or for making small amounts of solution.
5. A long-handled spoon for stirring.
6. Cheesecloth and a funnel for straining everything that goes into the spray tank.
7. A pair of pruning shears to cut off some infested plant parts occasionally before spraying.

8. Paper bags to collect the prunings for burning.
9. A pipe wrench, preferably two, of small size.
10. A pair of pliers.
11. A screwdriver.
12. Some wire that will fit into the hole in the spray nozzle.

After you get the spray solution in the tank, keep right handy the pipe wrench, pliers, and screw driver, for you never know when you will have to stop operations to screw or unscrew spray rods or nozzles, or to tighten screws and bolts. Pliers bite into the metal rod too much; hence the

Figure 5 *Helpful garden tools*

pipe wrench. You should keep in your pocket a short length of that wire for cleaning debris out of the nozzle at any moment, and back at the garage an extra cup leather for the plunger, a spare nozzle, and an assortment of bolts, for the best of sprayers break down at most inopportune times.

Making Up Spray Mixtures

Measurements must be exact. If you are measuring out a teaspoon of nicotine sulfate and your hand shakes so that you drop in an extra teaspoon you have increased the strength of your solution from 1 to 800 to 1 to 400, and the latter may be so strong as to injure tender plants. A chart hung up in the garage will save time. Copy off from the two tables here presented the data that fit your requirements, and *keep the information with your tools.*

TABLE I

Dilution Table for Contact Sprays

Amount of Finished Spray	*Amount of Spray Material to Use for Dilution* 1–200	1–400	1–600	1–800
1 quart	1 tsp.	½ tsp.	⅓ tsp.	¼ tsp.
1 gallon	4 tsps.	2 tsps.	1½ tsps.	1 tsp.
5 gallons	3⅕ ozs.	1⅗ ozs.	1⅕ ozs.	⅘ oz.
50 gallons	1 quart	1 pint	12 ozs.	8 ozs.
100 gallons	2 quarts	1 quart	1½ pints	1 pint

Whenever directions in bulletins call for 1 pint to 50 gallons or 1 quart to 100 gallons, or any other proportion, you can transpose the directions to your own needs by the table given above for liquids. Remember also your household measurements:

3 level teaspoons make 1 level tablespoon
2 tablespoons make 1 fluid ounce
16 tablespoons make 1 cup (or 8 fluid ounces)
2 cups make 1 pint
4 cups make 1 quart
16 cups (4 quarts) make 1 gallon

By a little figuring you can save much time in measuring. If directions call for 1⅔ tablespoons you can be exact by measuring 1 tablespoon and 2 teaspoons. Since your measuring cup is marked off in ounces, ¼ cup makes 2 ounces, or 4 tablespoons. It is quicker to measure out ¼ cup than 4 tablespoons.

If you are making up summer oils or other sprays that call for a 1–50 dilution, you can figure that if there are 16 cups in 1 gallon, then 3 gal-

lons make 48 cups, which is approximately the right amount of water to add to your 1 cup of oil.

Another point: that 12-quart pail does not really hold 3 gallons of spray without slopping over. It holds only 2 gallons easily, so measure out, with your quart jar (or a gallon cider jug), 2 gallons into the pail and mark the surface line with indelible pencil. It will save lots of time in the future.

TABLE II

Quantities of Dry Insecticidal Materials for Various Quantities of Water

Gallons of Water	*Weights of Material*				
100	1 lb.	2 lbs.	3 lbs.	5 lbs.	6 lbs.
50	½ lb.	1 lb.	1½ lbs.	2½ lbs.	3 lbs.
25	4 ozs.	8 ozs.	12 ozs.	1¼ lbs.	1½ lbs.
10	1.6 ozs.	3.2 ozs.	4.8 ozs.	8 ozs.	9.6 ozs.
5	.8 oz.	1.6 ozs.	2.4 ozs.	4 ozs.	4.8 ozs.
1	.16 oz. or .9 tbsp.*	.32 oz. or 1.8 tbsp.	.48 oz. or 2⅔ tbsps.	.8 oz. or 4½ tbsps.	.96 oz. or 5⅓ tbsps.

*These are approximate measurements for lead arsenate. Other materials will be slightly different.

TABLE III

One Ounce Weight Equivalents in Tablespoonfuls

Lead arsenate about 5½ level tablespoons per ounce
Calcium arsenate about 5 level tablespoons per ounce
Hydrated lime about 4 to 5 level tablespoons per ounce (varies somewhat)
Wheat flour about 4 to 5 level tablespoons per ounce (varies somewhat)
Skim milk, powdered, about 6 level tablespoons per ounce
Cryolite about 4½ level tablespoons per ounce
Wettable sulfur about 3 level tablespoons per ounce
Rotenone (4 per cent powdered) about 6 level tablespoons per ounce
Calomel (powdered) about 1¾ level tablespoons per ounce
Tartar emetic about 2 scant tablespoons per ounce
Sugar about 1⅔ level tablespoons per ounce

In transposing from the metric system:

28.35 grams equal 1 ounce
453.6 grams equal 1 pound

In making up dry materials into sprays the usual method is to mix chemicals or materials together (say lead arsenate and flour), then add water *very slowly,* while stirring constantly. This is called slurring, and even in making up large quantities, the dry mixes are slurried in a pail before the rest of the water is added to the tank.

If lime is added to a mixture, however, it seems to work better sprinkled on the surface of the diluted spray; and the same is true of some of the stickers and spreaders, which are added last. Nicotine sulfate is often added to the diluted soap solution. Dry mixtures usually have some inert materials which do not go into solution, so the diluted spray *should always be strained into the tank through cheesecloth.*

Manipulating the Spray Rod

Handling the spray rod to get complete coverage, yet not to drench the plants so the spray runs off or builds up too much residue, is where the fine art of spraying comes in. Success depends upon the operation of the pump. I have used the strong right arms of a good many assistants in spraying operations, and only about 1 in 3 operators has the sense of timing which will provide a mist spray coming out with good even pressure. Some pump so hard that the cylinder head is blown off; others are uneven, or never get up enough pressure to do a good spray job.

The type of spray droplets and the amount of unsightly residue depend somewhat on the hole in the nozzle. A very small hole is required for the mist spray we usually want for ornamentals. Since abrasive action of the chemicals is constantly enlarging the hole, it is a good idea to replace the worn nozzle with a new one about once a season—oftener if need be.

In spraying, work from several different positions; first from one side, then the other, then around from the back, keeping the rod continuously in motion, working in most cases from underneath and swooping the nozzle up through the foliage to get full coverage. When, however, you are interested in aphids on buds or new shoots, rose chafers, or diabrotica beetles chewing flowers, or thrips inside buds, then the spray is directed right at the buds or directly into the flower petals.

Timing the Spray

Generally speaking, exact timing may be more important in applying fungicides than in dealing with insects, but it does play a large part in the successful use of insecticides. The life histories given in the bug section often suggest the proper timing for control measures. Scale insects must

be gotten when the plants are dormant, or else with a summer spray when the vulnerable young crawlers are moving. Timing is all-important for the boxwood leaf miner, which can be controlled only during the 10 to 14 days per year when the flies are out. The most important spray time for codling moth is when most of the petals have fallen but before the apple calyx closes. The special rotenone sprays for Japanese beetles on grapes and other fruits last only 6 or 7 days. If the next spray is not applied promptly the beetles will get a head start. Roses and Boston ivy put out so much new growth so fast during the summer that it takes a spray at least every week, if not oftener, to keep the foliage from being chewed up. Rose slugs (sawflies) and sawfly larvae on pines do a lot of damage in the spring before you ever think of spraying for them, but both are easily and almost perfectly controlled if you start at just the right time.

Spray Injury

We have already touched upon various ways in which sprays may injure plants, but we'll summarize and add to that list here.

Arsenical Injury—Marginal burning, dead spots in leaves, or dead brown areas between veins. Lead arsenate injures beans severely; injures peaches, cherries, and other tender fruits unless safened with lime. (Figure 6.)

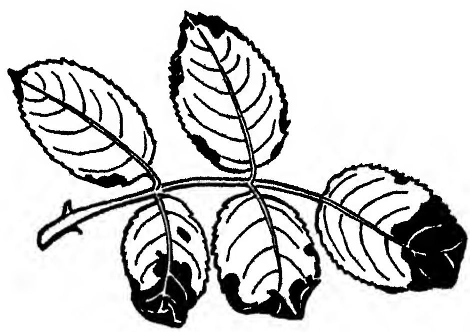


Figure 6

Rose leaf burned with an arsenical spray

Copper Injury takes many forms, is most serious in cold, wet weather when soluble copper is liberated from bordeaux mixture or other copper compounds.

On *apples,* in cool wet weather, or sometimes very hot and dry weather, the copper and lime in bordeaux mixture will cause purplish spots on leaves, russeting of fruit, premature leaf fall.

On *roses,* bordeaux may cause complete defoliation of some varieties,

especially in cool climates. Other copper compounds sometimes cause reddish spots on leaves and, with some varieties, yellowing of leaves and defoliation. Carnations, lilies, tulips, and other ornamentals may be scorched by copper in bordeaux mixture.

On *cucumbers,* copper may dwarf plants, yellow leaf edges, and delay ripening.

On *beans,* copper may, in cool, wet weather, cause a reduced yield.

On *tomatoes,* copper may kill blossoms and stunt plants, especially when applied to young seedlings.

Sulfur Injury—Most serious in very hot weather, but some plants, like *viburnum, cucumbers, melons,* and *squashes,* object to sulfur at almost any time.

Typical sulfur injury is a browning or scorching of tips and margins of leaves. With *roses, chrysanthemums, snapdragons* this may be combined with yellowing and dropping of leaves, and a bleaching of colored flowers.

Sugar Maple is subject to scorching of foliage with wettable sulfur, especially if the temperature is over 80° F.

Cherry is subject to leaf scorching and defoliation, reduced growth and yields.

Apples may be particularly subject to injury from lime-sulfur if apple scab lesions or other injuries break the waxy covering of leaves and fruit.

Other causes of injury include, as already discussed:

1. Failure to choose the right chemical.
2. Failure to measure dosage correctly.
3. Combinations of incompatible materials.
4. Using an incompatible material within a few days of the first treatment.
5. Climatic conditions in general—a spray may be safe in some parts of the country and not in others.
6. Climatic conditions at the time of spraying—too cold for oil sprays or copper; too hot for sulfur, et cetera.
7. Failure to clean the sprayer properly before and after use.

How to Clean a Sprayer

The best way to clean a sprayer is to *keep it clean.* Strain all mixtures into the spray tank through close-mesh cheesecloth, to avoid clogging the nozzles, and thoroughly rinse out the sprayer at the end of *every operation.*

This is necessary for the longevity of the plants as well as for the apparatus. Left-over solutions will have unpredictable and often injurious results. Never, never put away a sprayer without discarding all liquid left in the tank and pumping at least two changes of water through the entire

system. Don't just dump some water in and out again, but keep on pumping until the water comes out of the nozzle crystal clear.

Once or twice during the season more comprehensive treatment is needed. (See Figure 7.) Get together pails, some washing soda, and vinegar, or else some trisodium phosphate, a long heavy wire, stiff scrubbing brush, small bottle brush, wiping cloths, wrench, pliers, and screw driver. Take the sprayer apart as completely as you can—and don't lose any little washers in the process! Until this has been done once or twice, better make a diagram of where the parts go, so you can put them together again.

Drop the small metal parts—nozzles, brass strainer, et cetera, into a jar of kerosene; remove the hose connection and pour warm water, containing 3 or 4 tablespoons of washing soda (or trisodium phosphate) for each pail, into the metal tank. Let that stand while you poke the wire

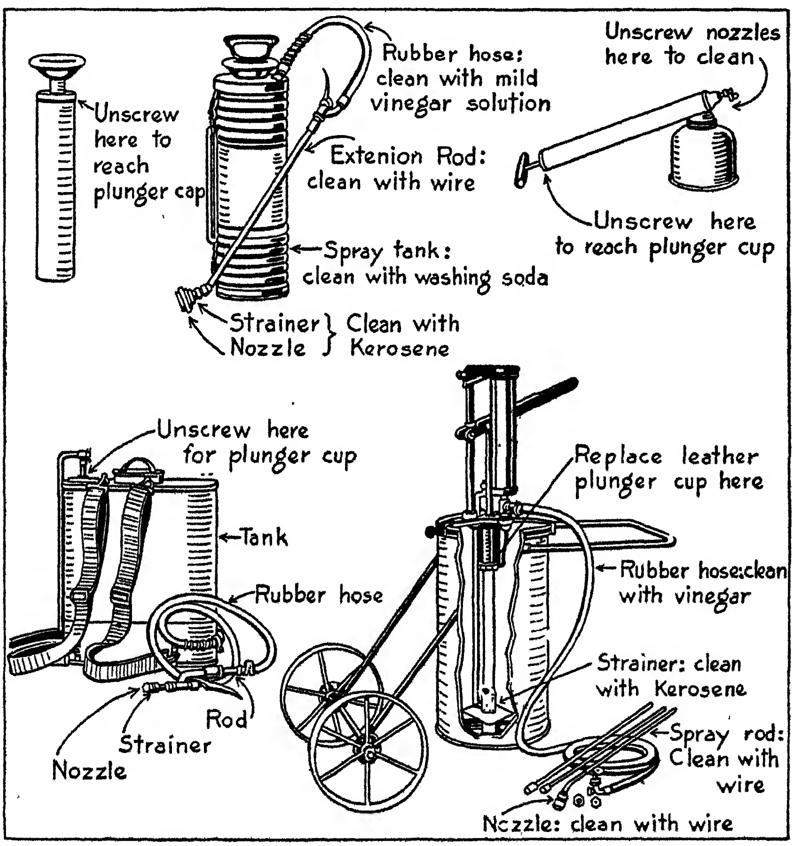


Figure 7 *How to clean a sprayer*

through the extension rods and then dip them into the solution in the tank. Use the scrubbing brush to get rid of accumulated spray residue on the inside of the tank, and use the small bottle brush to clean out the nozzles and strainers in the kerosene.

Having cleaned all metal parts, rinse the tank with pure water and start reassembling. Now is the time to put in a new plunger cup, if you have not been getting enough pressure. Work it in firmly but gently, using a little oil if necessary. Tighten all bolts with a wrench; connect the rubber hose, extension rod, and nozzle; and then pump through water containing a cupful or two of vinegar per pail. Finally, give one last rinse with pure water. Your sprayer should now be as good as new.

At the end of the season, before putting the sprayer away for the winter, follow exactly the same procedure, but leave it partly disassembled. Drain all water out of the hose and hang it up over a wooden peg, if possible where the temperature will not go below freezing. Coat the metal rods, nozzles, strainer, et cetera, lightly with oil. Wrap them in newspaper and tie all together onto the pump so that nothing will be lost. Keep the rubber washers and gasket in another package, without oil.

Sounds like a lot of work? It is. It may take 2 hours really to clean a sprayer; but it will probably save you several times that number of hours fussing and fuming with your sprayer next season. Make your original investment last 10 years instead of 1 or 2 and give you infinitely better results while you are spraying.

DUSTING PREFERRED?

Dusting has a place in every garden. In my own, I dust the vegetables and some ornamentals I don't care much about, and save spraying for roses and other flowers which are too glowingly beautiful to have their color dimmed by even the thinnest film of dust.

I don't subscribe to the theory that you do not have to get dressed in your old clothes for dusting and can do it any time you have a few spare moments. Dusts are harder on your shoes than sprays; you have to tie up your hair; you have to cover up your arms and clothes with a voluminous smock; and if you are using sulfur you have to cry yourself to sleep at night to get the particles washed off your eyeballs (I tried goggles just once). If you are using rotenone you get it uncomfortably into your lungs (I don't enjoy respirators any more than goggles); and if you are using Fermate (a new fungicide) you cannot get into a bathtub quick enough to wash off that blackish film.

There is also a theory that you can dust plants between showers, if necessary, and so get protection from a dust when there would be no chance to spray. But for ornamentals I believe just the opposite. If you dust a rose when the leaves are wet with either rain or dew, the dust goes on in lumps and stays in unsightly blotches that are an eyesore all summer. If you spray a rose when it is wet, you may not get the best control, and you may have to make a second application a little sooner than normally, but you have not spoiled the beauty of that rosebush for the rest of the season.

If, however, dust can be applied to a dry plant and can be blown up through the foliage from underneath, so that only a fine film settles down on upper surfaces, then dusts need not be too unsightly for the majority of plants. I much prefer a rotenone dust to any sort of spray in dealing with four-lined plant bugs on chrysanthemums and other ornamentals; I like sulfur dust for a few rose varieties which do not take kindly to copper; and I like the combination dust of sulfur and lead arsenate which will control slugs and rust at the same time on hollyhocks.

There is room for improvement in the types of dusters manufactured for home gardens. The small dust guns or plunger-type dusters are excellent for very small gardens, and so are the rotary and knapsack dusters for estate gardens; but for the ordinary average-sized back-yard garden we badly need something like the bellows duster, holding 2 or 3 pounds of dust, which was imported from Germany before the war. Why it has not yet been made in this country I do not know—perhaps it will be if there is enough demand for it. The little bellows dusters with a pint-sized jar fastened to them were at best wartime makeshifts.

Shaker-type Dusters—Cans or cartons with holes punched like those in salt shakers, are scarcely worthy of the name. They will sift some dry material unevenly over the tops of plants but rarely place it where needed. A cheesecloth bag beaten with a stick will come nearer to getting some dust on underside of foliage.

The Telescope-type Duster, often included as part of the purchase of a package of dust, consists of one cardboard cylinder telescoped within another. The mixture will not travel very far and there is difficulty getting adequate coverage of undersurfaces. It is handy for aphids and similar pests on buds and shoots.

The Dust Gun (Figure 8), or plunger-type duster, is excellent for a few plants. Some dust guns are made entirely of metal, others screw on to a glass jar. Some of the sturdily built all-metal dusters will last for years. They vary in capacity from 1 pint to 2 quarts. Some of the pint-size guns do not have an extension tube, but by getting down on your knees you can do quite a fair job of covering under-foliage. The 1- and

2-quart dusters have extension delivery tubes either with a flared nozzle, or a 2-way cap which can be easily changed back and forth for overleaf or underleaf dusting. Also, the 2-quart duster has a handle for easier operation.

Plunger-type dusters *should not be oiled,* but can be treated with powdered graphite when the plunger rod gets rusty or squeaky.

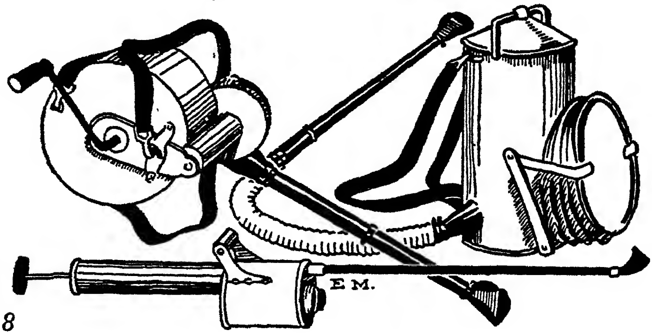


Figure 8

Dusters for the home garden: dust gun, rotary, and knapsack dusters

Knapsack Dusters, somewhat equivalent to knapsack sprayers, are designed for the larger garden. There is a large bellows type designed to be worn on the back, the operating lever worked up and down with the right hand while the flow of dust is directed with the left. A flared spreader tip makes possible a wide coverage.

The rotary or crank duster, a type of knapsack duster, is carried slung over one shoulder like the compressed-air sprayer. The crank is turned with one hand while the other directs the dust. The amount of dust to be applied per row can be regulated and the machine can be used with either 1 or 2 outlets. It is excellent for truck crops, flowers, and will take care of some small shrubs, but it is wasteful of dust if only 2 or 3 plants are to be covered. In a garden of any size it would pay to keep both a small plunger duster and a knapsack duster.

Even for a small garden it is a good idea to own two dusters. One big advantage of using dusts is that the apparatus does not have to be emptied and cleaned after use. If stored in a dry place the left-over dust can stay right in the dust gun. If, however, you want to use two kinds of dust, say a nicotine-and-lime mixture on some plants and a rotenone-and-sulfur combination on others, it would be very difficult and time-consuming to get all the last particles of one dust blown out of the duster before putting in the new mixture, and if you did not get out all the remains the plants might be injured.

Airplane dusting for large areas—cotton plantations, cranberry bogs,

forests—is carried on by commercial growers, who also use large power dusters similar to power sprayers.

Dusting is probably somewhat more foolproof than spraying, if you use only prepared mixtures and don't try to roll your own. I mean that "roll" literally, for in making dust mixtures at home you put the ingredients in a tin with some round stones and roll back and forth, round and round. However, it is not very good practice, and I almost always buy my dusts ready mixed. Most of the same warnings that are given under spraying apply to dusts.

FUMIGATION

Many operations come under the head of fumigation, which is treatment with volatile chemicals. There is greenhouse fumigation for living plants; fumigation of fallow soil for nematodes, wireworms, and other pests; fumigation of stored corms, bulbs, and seeds; fumigation of rodents in their burrows. Most of these have been treated to some extent under chemicals, and will be discussed further in the bug section. For fumigation methods in the small greenhouse I can do no better than to quote directly the entire article Dr. L. C. Chadwick wrote for the January 1945 issue of *The Home Garden,* entitled "Fumigation for the Small Greenhouse."

"Among the difficulties of growing plants under glass is that of contending with injurious insects. Temperature and humidity conditions are favorable for the existence and increase of many insects.

"Many greenhouse pests can be controlled by spraying with insecticides, but several are difficult to combat in this way. Consequently, fumigation becomes a practical and economical means of pest control.

"*Preparation of the Greenhouse for Fumigation.* To obtain satisfactory results from fumigation it is necessary to have the house as reasonably tight as it is possible to make it. Any broken panes of glass should be replaced. All glass should be well puttied in and all ventilators and doors should close tightly. Holes through which heating pipes run to the heating plant or to another house should be closed. Unless the fumes can be retained for a reasonable length of time the results from fumigation will not be satisfactory.

"Another precaution might be stressed: often the small greenhouse is attached to the residence, so every precaution should be taken to see that all entrances or openings from the house to the greenhouse can be closed tightly. This is necessary not only to retain the fumes for the proper kill

of the insects, but also to prevent the fumes from penetrating into the house where they might be injurious to human beings. This is particularly important where cyanide or Cyanogas is used as the fumigant. In fact, cyanide fumigation is not recommended for greenhouses attached to dwellings unless the occupants can leave the house during the fumigation period.

"The first step in fumigating the small greenhouse is to determine its cubic contents. It is not advisable to guess at the dosage of materials required. If the cubic contents of the house are accurately determined and the data recorded where it can be easily referred to, no time is lost in subsequent fumigations, and the dosage used, based on this determination, will prove satisfactory without danger of injury to the plants.

"To determine the cubic contents of the house, multiply the number of square feet of the end of the house by its length. Suppose, for example, the house is 30 feet long. The cubic contents of greenhouse A (an even-span house) is $\frac{10'+5'}{2} \times 20' \times 30' = 4{,}500$ cubic feet. Here we have obtained the average height of the roof $\left(\frac{10'+5'}{2} = 7\frac{1}{2}'\right)$ and multiplied it by the width (20′) and by the length (30′).

"To determine the cubic contents of an odd-span house (greenhouse B) it is necessary to find the square feet in area (a) and in area (b). In area (a) we have $\frac{10'+5'}{2} \times 6' = 45$ square feet, and in area (b) $\frac{10'+4'}{2} \times 14' = 98$ square feet. $45 + 98 = 143$ square feet; 143×30 (length of house) $= 4{,}290$ cubic feet.

"The cubic contents of a lean-to house (greenhouse C) is determined in a similar way: $\frac{10'+4'}{2} \times 10' \times 30' = 2{,}100$ cubic feet.

"*Fumigation Materials.* Three types of materials are commonly used for fumigation purposes. These are (1) nicotine or tobacco products, (2) cyanide products, and (3) naphthalene products.

"*Nicotine Products.* Nicotine is probably the safest and most effective fumigant for the control of aphids in the small greenhouse. It is also partially effective for control of whiteflies, midge, and thrips.

"The nicotine products are used mostly as nico-fume powder or nico-fume liquid. The old practice of burning tobacco stems is now in disuse because the nicotine content of the stems varied so much that one could not depend upon the results.

"Nico-fume tobacco powder contains 12 to 14 per cent pure nicotine

and is convenient to handle. The material may be purchased in ½-, 1-, 5-, or 10-pound cans. Since it deteriorates, it is best to purchase only small quantities at a time.

"Approximately 3½ ounces (one 2½-inch potful) to 5,000 cubic feet of space are required. Weigh out the correct amount of the powder and place it in a pile on the walk, or, better, on a narrow piece of 16- or 18-mesh screen, bent to a trough shape to hold the powder and with one end of the screen bent under to hold the screen off the floor. This gives more thorough combustion. It is best to divide the total amount of powder needed into several piles distributed evenly along the walks of the house. Close the ventilators about an hour before the fumigation is to start. Beginning at the far end of the house, light the piles and get out of the

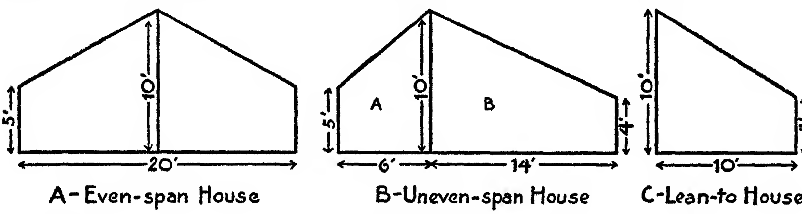


Figure 9 *Greenhouse types*

house as soon as possible. In 2 or 3 minutes vapor will be rising several feet and in 10 minutes total consumption of the powder will have occurred. The powder should smolder and not burn with a blaze.

"For large houses, the new pressure fumigators are more convenient. In this case, each fumigator contains ½ pound of the nico-fume powder, sufficient to fumigate 12,500 cubic feet. To use, all that is necessary is to punch in the eyelets at the top of the can and insert a burning lighter. The cans are set directly on the walk.

"These pressure fumigators can also be used for hand or 'spot fumigation.' Holders are available for the cans and with them you may fumigate by hand as you move along the walks, just as if spraying.

"Nico-fume *liquid* contains 40 per cent nicotine, which is liberated by heat. The liquid is applied to steam pipes, or evaporated over alcohol lamps. Either method is more bothersome than using the powder. The nico-fume liquid is used at the rate of ½ fluid ounce to 1,000 cubic feet of space. When the liquid is applied directly to the pipes it is advisable, if possible, to turn off the steam and let the pipes cool before applying the material. Otherwise the liquid evaporates so quickly that the operator does not have time to do a good job. The liquid may be applied with an oil can and the steam turned on.

"There are certain objections to this method, as can be readily seen.

In the summer, with no heat in the pipes, this method cannot be used. It may also be impractical to turn off the steam for an hour or more during cold weather. Furthermore, it is usually difficult to get at the pipes to apply the liquid.

"The method of vaporizing nico-fume liquid over alcohol lamps requires some apparatus. Iron crucibles of 4- to 5-ounce capacity, ring supports, and alcohol lamps are needed. The ring stand should be adjusted so that the flame is about 2 inches below the crucible. Two or more of the stands can be used in each small house. Not over 2 to 3 ounces of the nico-fume liquid should be placed in each crucible. One and a half or 2 ounces of alcohol are placed in each lamp. This is sufficient to burn for 1½ hours—long enough to vaporize the liquid.

"*Plants Sensitive to Nicotine Fumigation.* Violets, astilbe, and maidenhair fern are more or less sensitive to nicotine fumigation. Any blooms ready for cutting should be cut before fumigation. Cyclamen blooms are particularly sensitive to nicotine fumigation, but those of roses and carnations and most other flowering plants will stand the treatment unless the flowers are well developed and several fumigations are made within a few days' time.

"*Cyanide Products.* Calcium-cyanide fumigation is an effective means of controlling such greenhouse pests as whiteflies, aphids, soft scales, leaf tiers, and thrips. Complete control of all of these pests cannot be expected from a single fumigation, but 3 or 4 successive fumigations, at 2-week intervals, should be effective.

"The old practice of using sodium cyanide and sulphuric acid has now been largely discarded. Substituted for it is granular calcium cyanide supplied under the trade name of Cyanogas. Cyanogas gives off the hydrocyanic acid gas slowly, supplying a low concentration of gas during overnight fumigation.

"*This gas is poisonous* to human beings and every precaution should be taken in using it. Determine the cubic contents of the house and carefully weigh out the exact amount of material required. The margin of safety between the amount that will give an effective kill and the amount causing injury to the plants is small. Under ordinary greenhouse conditions, and for most plants, ¼ ounce of Cyanogas per 1,000 cubic feet is recommended. Application is made by spreading the granules evenly and thinly over the walks of the house, which have previously been wet down. A wide-mouth glass jar with a perforated metal top, the holes punched out from the inside with a 6- or 8-penny nail, makes a convenient container for scattering the material. A tin can with punctured holes in the cover may be substituted.

"*Factors and Precautions in Use of Calcium Cyanide.* Fumigation

should be done only at night, when the temperature is between 60° and 70° F. A rising temperature is more desirable than a falling one. The house should not be watered for 24 hours preceding the fumigation. Watering the plants immediately after fumigation should also be avoided. Fumigate during a clear, calm night. The walks need not be absolutely dry, but they should have no standing water. Since the gas liberated from the calcium cyanide never becomes highly concentrated, the gas will have practically disappeared by morning and extensive airing of the house is not necessary.

"If the house is tight, calcium cyanide at the rate of 1/4 ounce to 1,000 cubic feet should be satisfactory. In leaky houses it may be necessary to step up the dose to 1/3 ounce per 1,000 cubic feet, and to give successive fumigations.

"*Plants Sensitive to Cyanide Fumigation.* Sweet peas, asparagus fern, coleus, artillery plant, marguerite, wandering Jew, and snapdragon are sensitive to normal dosage, and the amount of calcium cyanide used should be reduced to 1/8 ounce per 1,000 cubic feet. Many plants will be injured if the concentration is increased to 1/2 ounce per 1,000 cubic feet of space.

"*Naphthalene Products.* Commercial flake naphthalene when vaporized in the greenhouse will control red spider and thrips satisfactorily. Two or more successive fumigations at intervals of 2 or 3 days may be needed to clean up a heavy infestation of red spider.

"Various types of lamps or stoves are recommended for vaporizing the naphthalene. A 2-wick coal-oil stove is probably the most practical. There is a type, designed for naphthalene fumigation, so constructed that the naphthalene flakes will melt but not boil. One stove is used for each 5,000 cubic feet of space. The cubic contents of the house should be determined and the naphthalene flakes used at the rate of 1 1/2 ounces per 1,000 cubic feet of space.

"*Plants Sensitive to Naphthalene Fumigation.* Injury from naphthalene fumigation may result from improper regulation of atmospheric conditions, improper adjustment of the vaporizer, or because the plants are sensitive. Proper regulation of atmospheric conditions and the vaporizer have been mentioned above.

"Geraniums, lilies, all types of roses, and tomatoes are intolerant of naphthalene fumigation. Begonias, Boston fern, carnation, and cyclamen are very tolerant. Most of the other common greenhouse plants are on the border line of safety, and conditions must be regulated carefully if injury is to be avoided. Certain varieties of chrysanthemums may become "blind" (no flower buds) if naphthalene fumigation is used during the bud formation period.

"*Conclusions.* While fumigation is a satisfactory means of controlling several greenhouse pests, the operation must be carefully performed and proper atmospheric conditions maintained, regardless of the material used. Unless it is possible to carry out the fumigation as stipulated, one should employ other means of pest control."

Chapter IV

INSECTS IN ORDER

THE ENTOMOLOGIST SAYS AN INSECT IS A VERY SPECIAL CREATURE WITH body divided into 3 sections, only 3 pairs of legs, and usually with wings. He also says a bug is a very special kind of sucking insect. The layman says any small crawling or flying animal is an insect and any insect is a bug. The dictionary says both are right, and in this manual we are stretching several points to include rabbits, dogs, squirrels and their relatives in the alphabetical list of garden pests we are lumping together, for practical purposes, under the one heading of "Bugs."

There are, in the world, a million different species of animals already classified, and probably as many more unclassified. These are all divided into main groups, known as Phyla, and then subdivided into Classes, Orders, Families, Genera, and Species. Let's take a quick look at the animal kingdom to see where our garden friends and enemies fit into the picture. Black-face capital letters indicate those groups of special interest to gardeners, and discussed in this book.

Phylum 1. **Protozoa**—1-celled animals.
" 2. **Porifera**—sponges.
" 3. **Coelenterata**—jellyfishes, polyps, corals.
" 4. **Ctenophora**—comb jellies.
" 5. **Platyhelminthes**—flatworms, tapeworms, flukes.
" 6. **Mesozoa**—degenerate parasites.
" 7. **Nemertinea**—unsegmented worms.
" 8. **NEMATHELMINTHES**—roundworms.
Class Nematoda—eelworms or nematodes, very injurious to plants.
" 9. **NEMATOMORPHA**—hairworms, seen occasionally in gardens, more beneficial than otherwise.

" 10. **Acanthocephala**—parasitic worms.
" 11. **Trochelminthes**—wheel animalcules.
" 12. **Bryozoa**—moss animals.
" 13. **Phoronidea**—sessile marine animals.
" 14. **MOLLUSCA**—shellfish.
Class 4. Gastropoda—snails and slugs.
" 15. **Sipunculoidea**—marine worms.
" 16. **Tardigrada**—bear animalcules.
" 17. **ANNELIDA**—segmented worms.
Class 3. Chaetopoda—earthworms.
" 18. **Onychophora**—caterpillarlike, with antennae.
" 19. **Pentastomida**—worm-like parasites.
" 20. **ARTHROPODA**—animals with segmented bodies; bilateral symmetry, chitinous exoskeleton; compound eyes; 6-segmented head.
Class 2. Arachnida—the spiders, ticks, mites.
Air-breathing terrestrial arthropods without antennae; 4 pairs of legs; body divided into cephalothorax and abdomen.
3. Crustacea—crayfish, sowbugs, lobsters, crabs.
With 2 pairs of antennae; mandibles on fourth head segment; usually aquatic, with blood gills.
4. Diplopoda—millipedes.
Tracheate, terrestrial arthropods with mandibles on fourth head segment; 2 pairs of legs on most body segments; 1 pair of unbranched antennae.
5. Symphyla—symphylids or garden centipedes.
Tracheate, terrestrial arthropods with mandibles on fourth head segment; 2 pairs of maxillae; y-suture on head; legs grouped into double pairs.
6. Chilopoda—true centipedes.
Tracheate, terrestrial arthropods with mandibles on fourth segment; 2 pairs of maxillae; pairs of legs not arranged in double pairs.
7. Hexapoda (Insecta)—all true insects.
Tracheate, mandibles on fourth segment; maxillae on fifth head segment; labium on sixth head segment; 3 pairs of thoracic legs; abdomen without functional legs in adult.
" 21. **Brachiopoda**—lamp shells.
" 22. **Chaetognatha**—arrowworms.
" 23. **Echinodermata**—echinoderms.
" 24. **CHORDATA**—possessing a notachord.
Class 6. Pisces—true fishes.

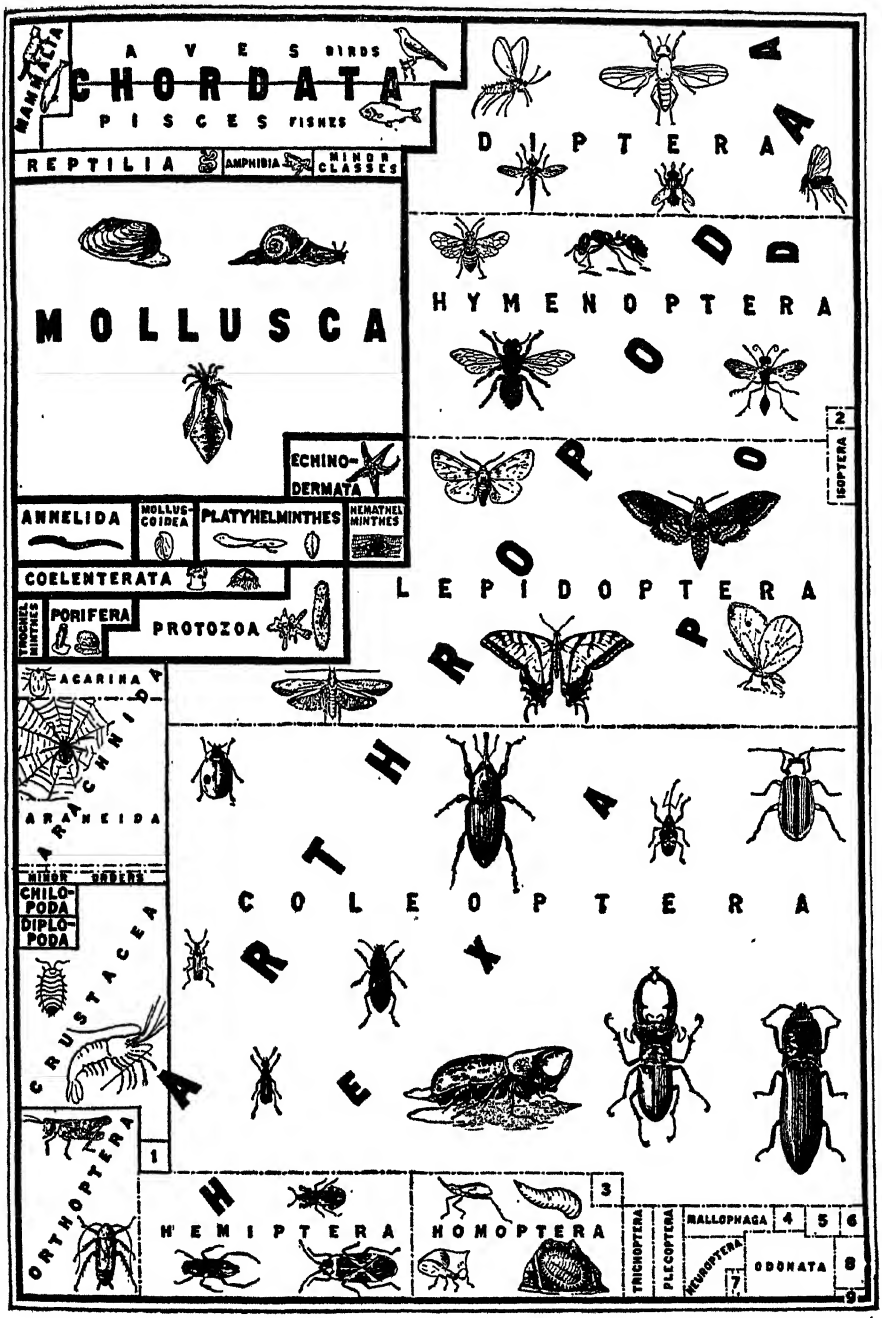


Figure 10

A diagram to show the relative size, in numbers of known species, of the various animal phyla (from Metcalf and Flint). Note the small number of mammals (Mammalia) compared to the insects (Hexapoda) and the large number of beetles (Coleoptera) compared to other insects

7. Amphibia—frogs, toads, newts, salamanders (all garden friends). With gills during larval stage and lungs in adult; scales usually absent; heart 3-chambered; with 4 legs adjusted for locomotion on ground.
8. Reptilia—lizards, snakes (also friends).
   Cold-blooded, usually with scaly skin; breathing by means of lungs; usually hatched from land egg; without functional gills; 3-chambered heart.
9. Aves—birds.
   Warm-blooded; lungs; 4-chambered heart; wings; feathers.
10. Mammalia—mammals.
    Warm-blooded; hair; 4-chambered heart; mammary glands; muscular diaphragm separating chest and abdomen.
    Order 3. Insectivora — hedgehogs, moles, shrews.
    6. Carnivora—cats, dogs.
    7. Edentata—sloths, armadillos.
    8. Rodentia — rodents; mice, squirrels, rabbits.
    11. Primates — monkeys and *man*.

Metcalf and Flint present a fascinating diagram to show the representative size, in numbers of known species, of the various animal phyla classes and orders. The mammals occupy a tiny little corner, about 10,000 species, or 1 per cent of the total known species, while the phylum Arthropoda contains about three fourths of all the known species; and in that phylum the Hexapoda, or true insects, take 90 per cent of the room, there being about 640,000 species of insects described by 1939. (Figure 10.)

INSECT MORPHOLOGY

Insects have an exoskeleton, a protective shell on the outside of soft body parts, rather than the internal skeleton of higher animals. The chief chemical in this outer covering is chitin.

The body of an insect is segmented, and divided into 3 main sections, the head, thorax, and abdomen. (Figure 11.) Six of the body segments are fused into the head. In the diagram is a chewing insect showing the biting mouth parts, compound eye, and antenna or feeler.

The middle section is called the thorax. The thorax is further subdivided into prothorax, just back of the head; mesothorax, bearing the

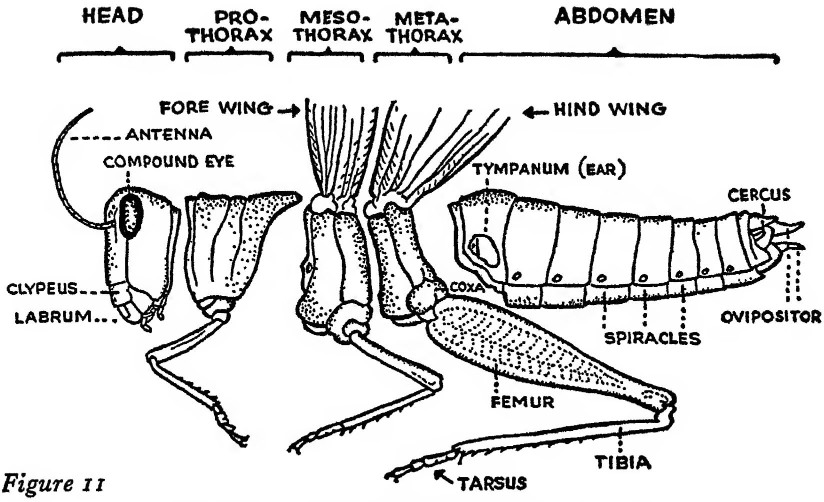


Figure 11

Diagram of an insect, showing important parts

pair of fore wings; and metathorax, bearing the hind wings. Each one of these thoracic segments bears a pair of legs, the total of 6 legs being the chief diagnostic character which separates insects from other arthropods. The word *arthropod* means jointed leg or foot, and insects are able to jump and hop about because of the way their legs are jointed. The first heavy leg section, corresponding to the thigh, is called the femur; the next the tibia; and the segmented foot is known as the tarsus. The number of segments in the tarsus is one of the characteristics by which insects are differentiated from one another. The type of veining in the wings is also important to the taxonomist.

The third section, the abdomen, is usually made up of 11 or 12 segments, one of them bearing, in the female, an ovipositor or egg-laying apparatus. The abdomen never has true legs but sometimes it has fleshy unjointed appendages known as prolegs.

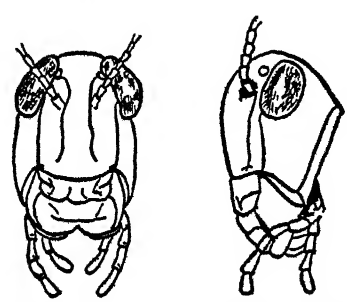


Figure 12

Front and side view of mouth parts of a chewing insect

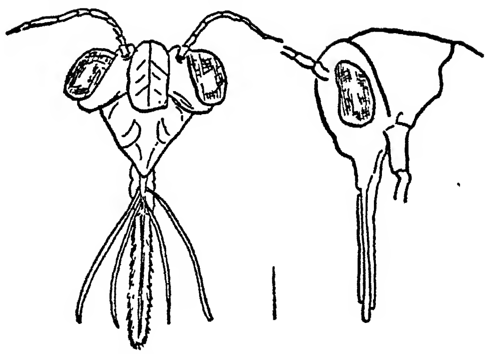


Figure 13

Mouth parts of a sucking insect

Insects breathe by means of spiracles. Spiracles are pores opening along the side of the body (on the thorax and abdomen, but not the head) into tubes called tracheae. *Contact poisons work largely because of the way they affect this respiratory system.*

Insects do not have a true ear, but have various organs for the perception of sound waves. In grasshoppers, as shown in the diagram, there is an oval plate (tympanum) on each side of the first segment of the abdomen, which serves as an ear.

Insects are classified primarily by the way they eat and the way they grow. The chewing insect, of course, bites holes in plants with its powerful jaws. (Figure 12.) The piercing-sucking insect has mouth parts modified for drawing out plant sap. It has an elongated beak made up of a grooved labium, and in the groove 4 slender pointed stylets which act as stabbers to pierce the epidermis and draw out the sap which is then sucked up or pumped up into a food channel. (Figure 13.)

HOW INSECTS GROW

Since insects live inside a chitinous exoskeleton which cannot be expanded as they grow, they progress by a series of molts, splitting and casting off the old shell or *cuticulum.* Such discarded shells are known as *exuviae,* which means clothes. Between the time the insect pulls free from its old covering and before the new form is heavily chitinized there is a chance for a good deal of expansion in size. The periods between molts are called *instars.* The egg hatches into the first instar, terminated by the first molt; this molt produces the second instar, where the young insect is larger and sometimes of different appearance. There may be 3 or 4 or 5, or even 20 molts, depending on the species.

The adult insect never increases in size; growth is always in the life stage that follows directly from the egg. Some insects have a simple or gradual metamorphosis, with the young resembling adults except for size and possession of wings. Such young are called *nymphs* during their growing period. Figure 14 shows insect metamorphosis in diagrammatic form. The bug hatches from an egg into a nymph, and grows in size through different instars (the number shown here does not represent the exact number for each species), acquires wing pads in the last instar, and then molts again into the adult bug with wings, which never grows any more.

Other insects have a complete metamorphosis, with the adult form totally different from the young insect. Here the young are known as *larvae* during the life stage following the egg.

The larva of a beetle is called a *grub*. It increases in size through different instars but does not change very much in appearance. It then turns into a quiet or *pupa* stage; and in the beetle this pupa is naked, with the form of the legs showing on the outside of the pupa case. During the pupa stage the beetle transforms into the winged adult.

The larva of a moth or butterfly is called a *caterpillar* and may change considerably in both size and appearance during different instars. The pupa may be a chrysalid attached to a twig by a strand of silk, or a naked pupa in the soil, or may be enclosed in a cocoon.

INSECT ORDERS

The orders of insects found in gardens are:

Collembola—Springtails, primitively wingless insects; without metamorphosis; chewing mouth parts.

CHEWING INSECTS WITH GRADUAL METAMORPHOSIS; WINGS DEVELOPING EXTERNALLY ON NYMPHS; NYMPHS WITH COMPOUND EYES

Orthoptera—Crickets, Grasshoppers, Katydids, Walkingsticks, Mantids.

Dermaptera—Earwigs.

Isoptera—Termites.

Thysanoptera—Thrips.

PIERCING-SUCKING MOUTH PARTS; GRADUAL METAMORPHOSIS

Homoptera—With uniform wings—Aphids, Scale Insects, Cicadas, Leafhoppers.

Hemiptera—True bugs, with "half wings," part hard, part membranous —Chinch Bugs, Stink Bugs, Leaf Bugs, Aquatic Bugs.

INSECTS WITH A COMPLETE METAMORPHOSIS; WINGS DEVELOP INTERNALLY IN LARVAE; LARVAE LACK COMPOUND EYES

Coleoptera—Chewing mouth parts in larvae and adults—Beetles, Weevils.

Neuroptera—Chewing in larvae and adults—Aphid Lions; Ant Lions.

Lepidoptera—Chewing mouth parts in larvae; siphoning in adults—Butterflies, Moths, Skippers.

Hymenoptera—Chewing mouth parts in larvae, often chewing-lapping in adults; 2 pairs of wings joined together—Bees, Wasps, Ants, Sawflies.

Diptera—Chewing mouth parts in larvae, piercing-sucking or sponging in adults; only 1 pair of wings—Flies, Gnats.

NAMES OF INSECTS

The only sure way to identify any particular insect is by its scientific name. Common names vary widely, not only in different parts of the country but with different gardeners in the same section. In one issue *The Home Garden* carried a small paragraph about "aster beetles," and I have been wondering ever since whether the writer meant Asiatic garden beetles, which come out to chew at night; or blister beetles, which are very common on asters in late summer; or perhaps some other beetle.

Insects are named by the universal system of binomial nomenclature. The first name is the genus name, corresponding to your own last name; and the second name is the species name, which really corresponds to a person's first name, for there can be several species in a genus just as there can be several children in a family, all with the same last name but with different given names.

If the aster beetle spoken of above had been the Asiatic garden beetle the words *Autoserica castanea* put in italics would have identified it beyond doubt. If it had been the Asiatic beetle its name was *Anomala orientalis.* If the aster beetle had been the black blister beetle, *Epicauta pennsylvanica* would have told me; and if it had been the striped blister beetle, *Epicauta vittata* would have been the word for that.

You will notice in these examples that the species name is usually descriptive: *castanea* refers to the lovely chestnut color, *orientalis* and *pennsylvanica* refer to places of origin, while *vittata* means striped. In fact, the names often tell you a whole lot about the insects; and besides, you need the names to look up more information in books. Unfortunately, with insects as with plants, names get shifted around a bit. A species is put into another genus, or the original name for the genus is revived, or one genus is split into two, and so on. But such changes are few in proportion to the total number, and of more concern to the entomologist than to the gardener.

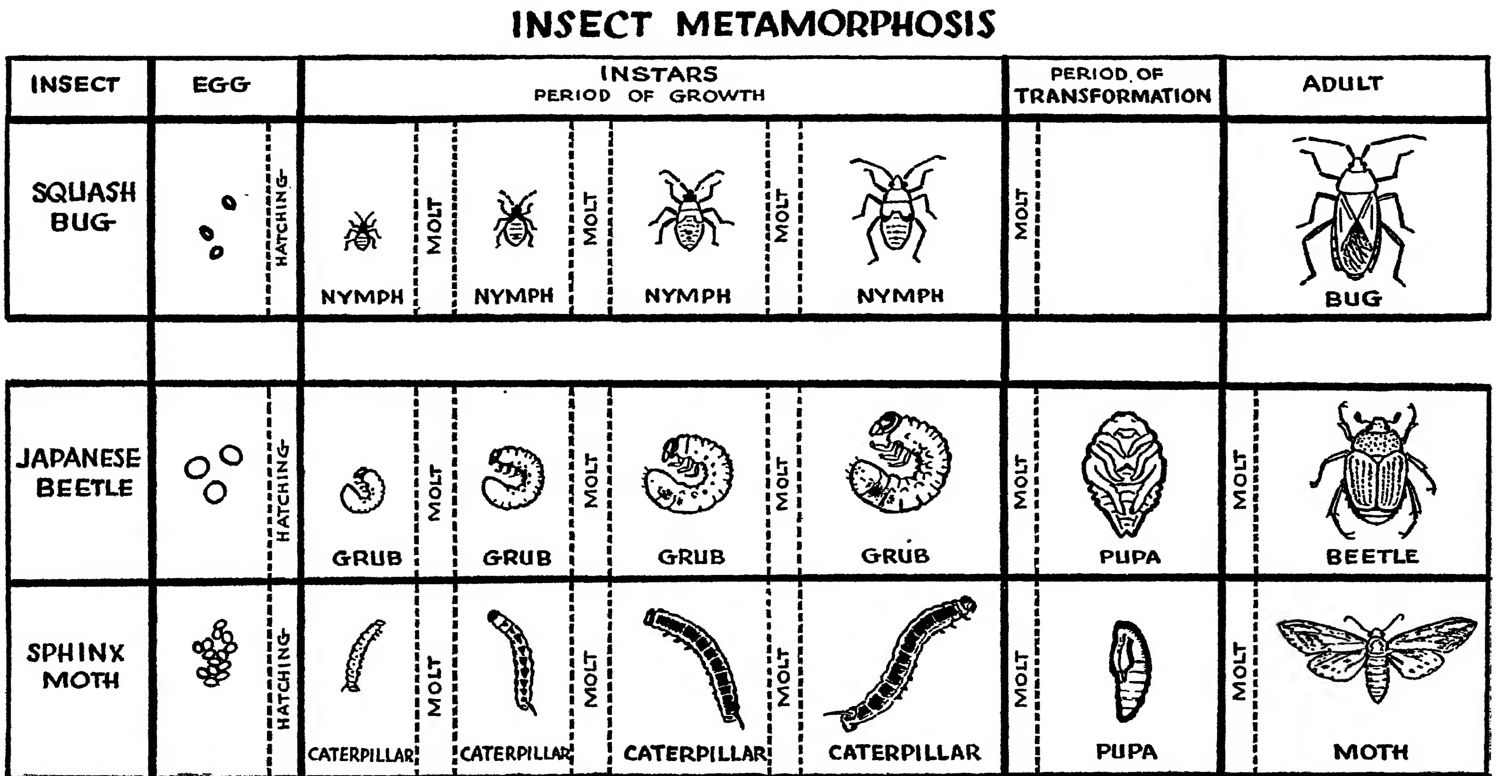


Figure 14 *Metamorphosis or growth stages of a sucking insect (squash bug) with gradual metamorphosis; and also of a beetle and a moth (chewing insects) with complete metamorphosis*

Chapter V

THE BUGS

After the preliminary survey of the preceding chapter, at last we come to them—the bugs and other insects, the slugs and snails and sowbugs, the mice and moles, birds and beetles, friends and foes—all grouped as we commonly think of them, and then discussed alphabetically under the different groups, which are themselves in alphabetical order.

A borer may be either a moth or a beetle, but if it is commonly called a borer, it is discussed under Borers. But if the borer, for instance the shot-hole borer, should be more commonly known under its other name—the fruit tree bark beetle—then it would be treated under Beetles. With the aid of cross-references and the Index, you can probably find the pest you want quite quickly if you know some common name for it.

If, however, all you know is that you have a caterpillar on a cherry, turn to the following plant section (Chapter VI) and look up Cherry. There you'll find a long list of pests with a short summary, or perhaps a kind of key to the most important ones. If you cannot find your bug in the important pests, then you will have to look back in the Bug section under the name of each minor pest of the cherry that might be a caterpillar.

But don't expect to find all the bugs in your garden even in this big book. Out of the nearly three quarters of a million insects in the world more than six thousand are of economic importance on plants in this country—on farms, in forests, in gardens. Lack of space and lack of any practical information concerning some of them have narrowed the number of insects included here to about one thousand. Farm and forest pests are eliminated unless they also are a nuisance in the home garden, but pests of ornamentals are included even if they are found in only one or two sections of the country.

I know that I cannot speak with the same authority about Florida and California, or even Illinois, insects as I do about those insects I fight in New Jersey. But I have done the best I could to make the list representative of the United States as a whole and not too much biased by my eastern residence.

Common names used here are those approved in 1942 by The American Association of Economic Entomologists, the scientific names representing current usage at that time in the Division of Insect Identification, Bureau of Entomology and Plant Quarantine. For insects not on the approved list I have used the names which seem most commonly accepted in current "bug" literature.

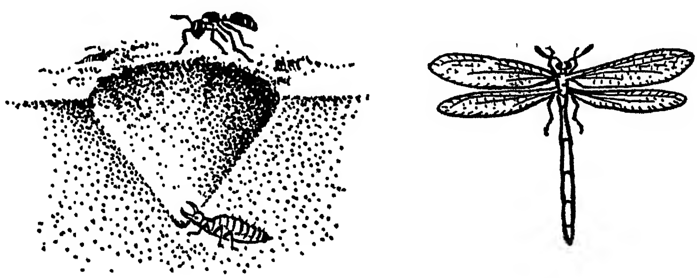


Figure 15

Ant lion larva waiting at the bottom of the pit dug for its ant victim, and winged adult ant lion

Ant Lions (*Myrmeleon* sp.)—Also called doodlebugs, family Myrmeleonidae, are named from the larvae which dig pitfalls in sandy soil to catch ants. The ferocious-looking "lions" lie at the bottom of funnel-shaped pits, buried in the sand with only their prominent jaws protruding to snap on an unwary ant falling into the pit. The larva pupates in a silken cocoon and turns into an adult utterly unlike its ugly youth—a delicate-bodied 4-winged fly, something like a dragonfly. It belongs to the insect order Neuroptera, meaning "nerve-winged," and has membranous wings marked with many veins. (Figure 15.)

ANTS

Ants are said to outnumber in individuals all other terrestrial animals and are to be found everywhere from the arctic to the tropics, on mountains or seashore, in wet regions or driest deserts. They belong to the order Hymenoptera, along with the bees and wasps. Probably most of

the more than 8,000 species are harmless, or possibly beneficial to man, but some species are definitely noxious, a nuisance in house and garden. Those of us who garden in the East fuss a little about ants in lawns and ants carrying around root aphids, but we'd have to move to the South or Southwest really to appreciate ant trouble.

Ants have a complex social life that has fascinated naturalists for generations, but I suggest Maurice Maeterlinck's classic, *The Life of the Ant,* as the most painless way of acquiring a general knowledge of ants and their strange ways.

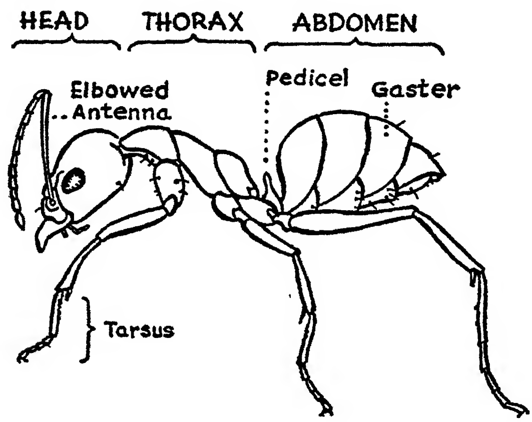


Figure 16

Diagram of an ant

The body of an ant is sharply constricted into the 3 divisions of head, thorax, and abdomen. (Figure 16.) The antennae are hinged like an elbow, and club-shaped at the tip. The abdomen, called a gaster, is attached to the thorax by one or two segments known as pedicels.

Each ant species consists of 3 castes—sterile workers, which are wingless males and females, and queens (fertilized females) which shed their wings after mating and found new colonies. They live in colonies in nests with intercommunicating cavities in the ground or in decaying wood. When these nests are in lawns the mounds of earth are disfiguring; when near garden plants the roots are disturbed and the plants die. Even trees are sometimes killed by the agricultural or harvester ants of the Southwest.

The food of ants is extremely varied. Some live on household foods, sweets or fats, some on aphid honeydew, some on fungi which they cultivate in their nests, some on seeds, grains, or vegetable roots.

An ant colony is made up of 1 or 2 queens, which spend their lives

laying eggs, and thousands of workers which feed the queens and tend the young ant larvae, maggot-like grubs.

The most successful control measures are those using a slow poison which the workers will carry back to the nest.

Argentine Ant (*Iridomyrmex humilis*)—First noted here in 1891, thought to have been brought into New Orleans in shipments of coffee from Brazil. It is now distributed chiefly in the southeastern quarter of the United States, and also in California, as a most serious household and garden pest. The workers are small, less than 1/8 inch long, brown; the queens darker and about three times as long. They nest in large colonies under stones or pavements, or in cracks in soil, in orchards, lawns, or gardens. They are fond of both sweet and animal food, and distribute scales, aphids, and mealybugs about the garden for their honeydew.

The government Argentine Ant Bait, adjusted to small quantities, is:

1 1/4 lbs. granulated sugar 1 1/4 pints water 1 gram tartaric acid (crystallized) 1 gram benzoate of soda	Boil together for 30 minutes and cool

1/8 oz. sodium arsenite dissolved in 1 fluid oz. hot water and cooled.

Add the second mixture to the first, stir well, then add 2/3 lbs. strained honey.

The mixture is put into ant cups, tin containers with indentations or holes to admit the ants, placed 20 to 25 feet apart, out of reach of children. Community campaigns are needed to clear neighborhoods of Argentine ants. Commercial ant baits, that come ready-prepared in ant traps, are probably easier, and safe to use.

Black Carpenter Ant (*Camponotus herculeanus pennsylvanicus*)—Responsible for a lot of damage attributed to termites, since it nests in logs, tree trunks, or timbers of buildings. It is a very large black ant, in eastern half of United States.

Cornfield Ant (*Lasius niger americanus*)—A native species, distributed over most of the country. It is small, robust, light to dark brown, nesting mostly in soil in open places, sometimes in lawns, or in rotten wood. It is injurious chiefly as a distributor of corn root aphids. The ants caress the aphids with their antennae, stimulating the production of honeydew, put them in the right place for proper winter hibernation, and protect them from their enemies. See Corn Root Aphid.

California Harvester Ant (*Pogonomyrmex californicus*)—Common in Texas, New Mexico, Arizona, California, and Nevada. It is pale red, workers about 1/4 inch long, queens slightly larger, bites and stings furiously. The ants collect seeds all day long, thereby interfering with planting operations. Their nests are always in sand, and their habit of clearing away all vegetation around the nest is most injurious.

Fire Ant (*Solenopsis geminata*)—Small, pale yellow or red, traveling in columns, stinging severely, ranging from the tropics into the Southwest. In Arizona this ant eats tender shoots of nursery and orchard trees, nests in strawberry patches in California, and debarks young citrus trees; sometimes girdles young vegetables. It is best controlled by soil fumigants.

Little Black Ant (*Monomorium minimum*)—A native species, 1/10 to 1/12 inch long, shiny black, nesting outdoors in soil, sometimes in woodwork of buildings, feeding on sweets, honeydew, fruits, vegetables, or meats.

Odorous House Ant (*Tapinoma sessile*)—A native, deep brown to black species, 1/10 to 1/8 inch long, broader and less agile than the Argentine ant. When crushed it has a nauseating, sweetish odor. It eats everything, but is especially fond of sweets and attends honeydew-secreting insects.

Pavement Ant (*Tetramorium caespitum*)—Hairy, robust, hard-bodied, black with pale appendages, no club on antennae, 1/12 to 1/7 inch long. It is common in lawns, nesting under stones or pavements, and forages into houses and greenhouses. It eats roots and stalks of potatoes, beets, cabbage, carrots, and other vegetable roots, and steals seeds. It attends aphids, scale insects, and leafhoppers. Experiments in Virginia showed naphthalene flakes helpful in preventing damage to eggplant from this ant.

Pharaoh Ant (*Monomorium pharaonis*)—A tiny, 1/12 to 1/10-inch-long red ant, nesting in inaccessible places in walls of buildings or in soil in California, foraging indoors in search of food, eating proteins as well as sweets.

Red Harvester Ant (*Pogonomyrmex barbatus*), also known as the **Texas Harvester** or **Agricultural Ant**—It is 1/4 inch or more long, black head, thorax, and legs, red pedicel and abdomen. It lives in large colonies, clearing the soil of all vegetation and often making bare circles in gardens or around trees 2 to 12 feet in diameter. It is particularly injurious in Arizona and other parts of the Southwest. The nest is deep, with the queen 2 to 6 feet underground, so that control by applying gas or liquid poisons directly is not very satisfactory. It is better to trick the workers into carrying poisons down underground. The ants recognize poisoned seed but will walk through a circle of powder placed around, but 10 to 12 inches from, the entrance to the nest. A formula developed at the University of Arizona seems satisfactory for this agricultural ant:

Sodium arsenite	20 per cent	by weight	
Cornstarch	5 per cent	"	"
Paris green	1 per cent	"	"
Calcium carbonate (precipitated) or gypsum	74 per cent	"	"

Thoroughly rotate the mixture until the greenish color is diffused throughout.

Texas Leaf-cutting Ant (*Atta texana*)—A native, confined to southern and eastern Texas and western Louisiana, interesting from its habit of cutting leaves from plants. These are macerated, fertilized in the nests, and in this leafmold compost the ants grow a fungus for food—a method comparable to man's culture of mushrooms. They are serious pests of garden and field crops.

Thief Ant (*Solenopsis molesta*)—Yellow to bronze, smaller than the Pharaoh ant, a common house pest in warm weather with a preference for meats and other protein foods. It also injures germinating grain seeds.

General Control Measures for Ants

1. Saturate nests, under pavements, et cetera, with kerosene, if plants are not too near.

2. Apply sodium fluoride dust to nests; this can be used near plants.

3. For nests in soil or lawns punch holes several inches deep with a stick, and pour a little carbon bisulfide into each hole, either through a funnel, or injected with a machine-oil can. *Caution: carbon bisulfide is highly inflammable.*

4. Use a tablespoon of calcium cyanide (Cyanogas) in holes in nests. *Caution: this is a deadly poison; do not breathe fumes; do not let it touch wet skin.*

5. Try crystals of paradichlorobenzene or naphthalene flakes in nests if not near plants.

6. For colonies in and around growing plants, pour on a pyrethrum-soap solution.

7. *Use ant baits.*

For sweet-loving ants use Argentine Ant Bait (formula given above).

For protein or grease-loving ants—Pharaoh ant, thief ant—poison bacon with a small amount of sodium arsenite, or mix 10 grains arsenite with 1½ pints grease.

Thallium sulfate baits for either grease-loving or sweet-loving ants are on the market. See Ant Baits under Garden Chemicals. (Chapter II.)

Caution: Thallium sulfate is a deadly poison. It should not be mixed at home and care must be taken to protect children and pets from baits ready prepared.

Aphid Lions (*Chrysopa* spp.)—Larvae of lacewing flies, family Chrysopidae, order Neuroptera. The larvae help the gardener keep aphids under control. They are flat, with elongated bodies tapering at both ends, yellowish or gray, mottled with red or brown, with projecting hairs or bristles, about ¼ to ⅓ inch long and a quarter as wide. The head bears double sickle-shaped jaws used to capture, puncture, and extract the juice from succulent plant lice or mealybugs, sometimes from grasshoppers, thrips, and mites. The larva pupates in a globular white cocoon in crevices, or under bark, and when adult, cuts out a small lid which swings back as on a hinge.

Figure 17

Aphid lion: stalked eggs, larva, pupa case, and lacewing adult

Known as golden-eye lacewing, the adult has gauzy green wings and, often, gold eyes. The female, knowing her offspring to be cannibals and ready to eat one another as well as aphids, places each small white oval egg at the end of a hair-like stalk drawn out from her body. Leaves and twigs often show clusters of these strange stalked objects. (Figure 17.) There may be several generations a year. The adults apparently do not feed, but the larvae eat from 200 to 400 aphids apiece before they reach full development.

APHIDS

Aphids, or plant lice, belong to the insect order Homoptera, the family Aphididae. There are a great many species abundant on and injurious to all forms of vegetation. At least a few species are inevitable in every home garden, and sometimes it seems much easier to control aphids than to understand their complicated life histories.

Aphids are sucking insects, soft-bodied, usually pear-shaped, sometimes with wings, sometimes not, but in most species having a pair of tubes

or cornicles (Figure 18) projecting from the abdomen. The antennae have 3 to 6 segments and the tarsi 2. Some aphids secrete a white, wax-like substance which makes them look woolly or powdery. All aphids secrete a colorless sweet substance, honeydew, which attracts ants and is also a medium for the growth of a black fungus known as sooty mold.

Many aphids live out their lives on a single host or food plant; others feed on 2 or 3, or even many, different plant species; still others require an alternate host, wintering on one type of plant, usually woody, then migrating to one or more herbaceous species for the summer.

The life history of an aphid is complicated even for the single-host type. In a typical case overwintering eggs hatch in spring into wingless females called stem mothers. These parthenogenetic (reproducing with-

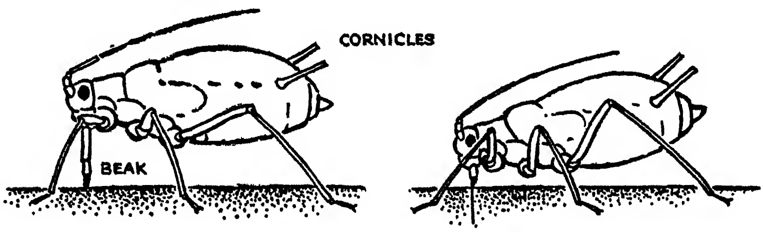


Figure 18

An aphid getting ready to feed and in process of sucking sap

out fertilization) females are viviparous—that is, they hold their eggs in their bodies and give birth to living young. These young are also parthenogenetic females, but some may develop wings and migrate to other plants of the same species. Many more such generations are produced during the summer, but toward autumn male and female wingless forms are born. These mate, and the oviparous females lay fertilized eggs for overwintering. In warm climates living young may be produced continually with no overwintering egg stage.

Alternate-host aphids may also winter in the egg stage, but in the third or fourth parthenogenetic generation they produce winged females which migrate to the summer food plant. On the summer host there may be a half dozen or more generations of wingless females before winged forms appear for the trek back to the woody winter host. There the winged females give birth to wingless females, which are fertilized by winged males flying over from the summer host. Is your head going around in cycles too? Perhaps now you can readily understand why no one has yet figured out the complete life cycles of many of these alternate-host aphids!

Aphids injure plants by stunting growth, deforming buds or shoots,

producing galls, producing honeydew for the sooty mold fungi to grow in, and, perhaps most important, by acting as carriers or vectors of virus and bacterial diseases.

Most aphids are readily controlled by applying contact insecticides at the proper time. Nicotine sulfate (Black Leaf 40) is the aphicide *par excellence*. The usual dose is 1 to 1½ teaspoons plus 1 ounce of liquid soap or 1 cubic inch of soap flakes per gallon of water. Rotenone or pyrethrum sprays or dusts are usually satisfactory; and a 3 per cent nicotine lime dust is often recommended.

Personally I'd rather spray aphids than dust them because of the mechanical washing action of a spray. In fact, if you have no insecticides at hand you can wash off many aphids with a strong stream of water from the hose. Overwintering eggs on fruit trees are usually taken care of by a dormant spray of oil, or one of the dinitro compounds, in early spring.

Timing is important in aphid control, not only to kill the first few aphids before they can reproduce but also to avoid killing natural parasites or predators such as ladybeetles, syrphid flies, and aphid lions. A good example of the latter happened recently in California. Nicotine dust normally gives excellent control of the walnut aphid, but in one orchard where dusting was delayed until gray ladybeetles and syrphid flies were numerous there was more aphid damage than in undusted orchards. The nicotine had killed the predators and allowed a large second generation of aphids to build up. DDT is also effective in killing walnut aphids but it, too, kills predators and thus in a roundabout way encourages a large aphid population.

Parasites—insects which live part of their lives *inside* other insects, instead of merely preying upon them—are important in aphid control. Figures 19, 20 show a hymenopterous wasp laying an egg in an aphid, then the young wasp produced from the egg emerging from the aphid, and

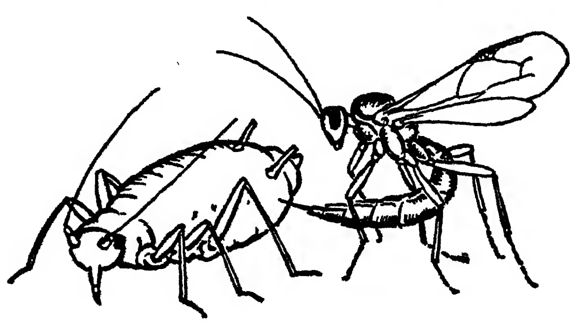


Figure 19

Parasitic wasp laying egg in an aphid

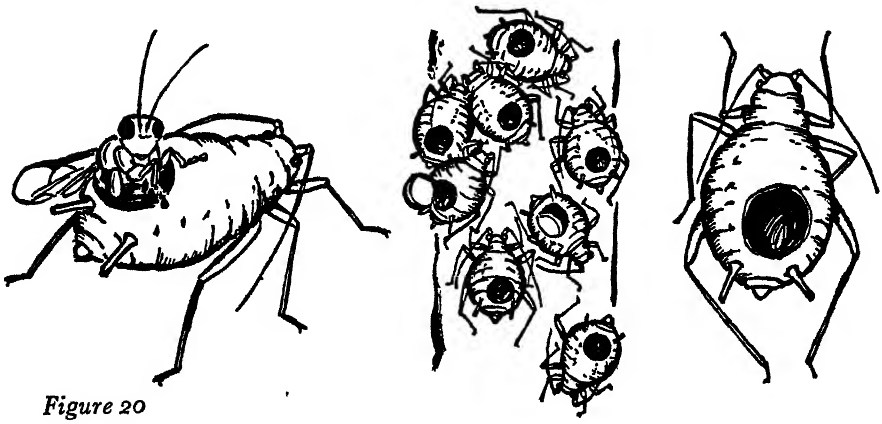


Figure 20

Young wasp emerging from parasitized aphid, and dead aphids showing emergence holes (greatly enlarged)

finally the stiff dead bodies of parasitized aphids, all showing emergence holes in their backs. Whenever you find dry, brown aphid bodies with holes you may be sure you have friends in the garden.

In the following pages aphids are taken up alphabetically under their common names. Those of much economic importance are treated in some detail; others are dismissed in a line or two, giving host plants and salient characteristics. Though the list is long it includes but a fraction of the thousands of plant lice in the world—a fraction intended to be representative of aphids injuring trees, flowers, or vegetables on home properties in different sections of these United States.

Apple Aphid (*Aphis pomi*)—Often called green apple aphid, a single host species on apple, pear, wild crabs, hawthorn, distributed generally in apple sections of North America. Shiny black eggs winter on twigs, producing green aphids which swarm on fruit buds, distort young apples. Add nicotine sulfate to delayed dormant spray; or use a dinitro compound such as Elgetol.

Apple Grain Aphid (*Rhopalosiphum prunifoliae*)—Winters as eggs on apple, pear, or hawthorn twigs; produces greenish-yellow lice which migrate to small grains and grasses for almost the entire feeding period. No control on apple is necessary.

Arborvitae Aphid (*Dilachnus tujafilinus*)—Brown, covered with whitish bloom, prevalent in California and some southern states on arborvitae, Italian cypress, and retinospora. This species produces much honeydew for sooty molds to grow in.

Artemisia Aphid (*Macrosiphum artemisiae*)—Dark green or black,

often present in dense colonies on shoots of artemisia in California, Colorado, Washington, Oregon.

Artichoke Aphid (*Myzus braggi*)—Pale yellow and green with darker green markings, often abundant on globe artichoke in California and Louisiana. Elaeagnus, Russian olive, and shepherdia are winter hosts; various thistles summer hosts.

Aster Aphids (*Macrosiphum anomalae, M. asterifoliae*)—Greenish lice on New England aster.

Aster Root Aphid (*Anuraphis middletoni*)—Light gray or dark green, common on roots of aster, buttercup, cosmos, dahlia, erigeron, and other composite flowers and weeds. Sometimes it may be killed by scooping away some of the soil around the plant and pouring in a nicotine or pyrethrum solution made up as for spraying. (Figure 21.) See also Corn Root Aphid.

Aucuba Aphid (*Macrosiphum aucubae*)—Green aphid reported on this host.

Balsam Twig Aphid (*Mindarus abietinus*)—Greenish aphid covered with white wax, prevalent on young shoots of white and balsam firs. Shoots may turn red and die.

Control. Spray in late spring or early summer with nicotine sulfate and soap.

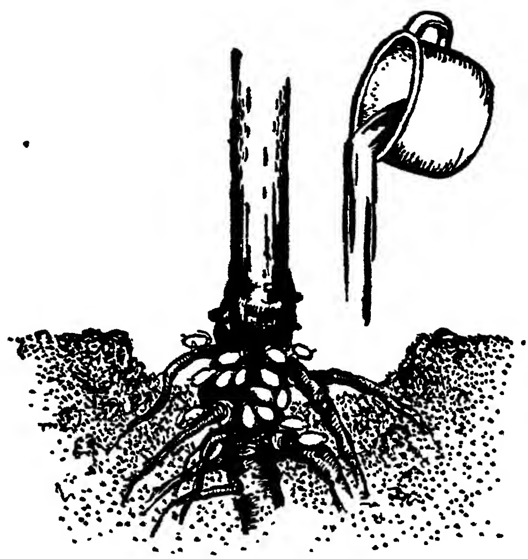


Figure 21

Root aphids controlled by making a depression in soil around plant and pouring in a solution of nicotine sulfate

Bamboo Aphid (*Myzocallis arundinariae, M. arundicolens*)—Yellow with black markings, common on leaves of bamboo in California.

Banana Aphid (*Pentalonia nigronervosa*)—Reddish-brown to nearly black with dark, clouded wings, often imported on bananas and reported on geranium.

Barberry Aphid (*Lisiomaphis berberidis*)—Small, yellowish-green, abundant on leaves and tender shoots of barberry generally, and on Oregon grape in California.

Bean Aphid (*Aphis rumicis*)—A common, important, dull black species, sometimes very dark green with nymphs often spotted with powder-white wax. It is very gregarious, congregating in great numbers on succulent plant parts, causing general plant debility and yellowing foliage. It is the bean aphid that is practically synonymous with nasturtium, thickly infesting undersides of leaves and stems. (Plate I, page 78.) And it is the bean aphid which so thickly infests English ivy when it is brought indoors.

This is one of the alternate-host species, wintering on euonymus and dock, migrating to globe artichoke, asparagus, bean, beet, broom, cowpea, dahlia, deutzia, English ivy, nasturtium, oleander, parsnip, pea, poppy, rhubarb, spinach, thistles, watercress, zinnia, and many weeds, for the summer.

Control. A 4 per cent nicotine dust, or a nicotine-sulfate-and-soap spray, should be successful. If house ivies are treated to the weekly bath needed to keep down red spiders, aphids won't have much of a chance. The tips of growing sprays can be dipped in soap solution or nicotine or pyrethrum insecticides. The chief difficulty in controlling bean aphids on nasturtiums is trying to wet them with a spray, since it requires a curved or swivvle nozzle and a good deal of patience to cover thoroughly the underside of nasturtium leaves.

Beech Blight Aphid (*Prociphilus imbricator*)—Produces masses of bluish-white woolly lice on undersides of beech limbs, often abundant enough to kill twigs and young trees. Spray with nicotine oil when dormant in the spring. See also Woolly Beech Aphid.

Beet Root Aphid (*Pemphigus betae*)—Small, wingless, oval, white, with a cottony tuft over the end of abdomen. It feeds on roots of beet, dock, aster, and many weeds and wild grasses, and then produces winged forms, black with a white waxy covering, to migrate to poplar for winter. It feeds on poplar leaves in spring before returning to beet. Reported from most states, it is common in the West.

Begonia Aphid (*Macrosiphum begoniae*)—A greenish species which may seriously injure greenhouse begonia. Spray with nicotine sulfate and soap before blossoming; with pyrethrum during the blooming period.

Black Cherry Aphid (*Myzus cerasi*)—Large, metallic, black species

common and abundant on sweet cherry, curling and distorting leaves. Cherry is the winter host; in late spring the aphid disappears, probably to summer on cruciferous plants. It is also present on sour cherry, but does not curl the leaves.

Control with a dormant tar-oil or dinitro spray; or with nicotine sulfate and soap at the green-tip stage.

Black Citrus Aphid (*Toxoptera aurantiae*)—Reddish-brown or shiny black; important on citrus in coastal districts of California and in Florida. Dust or spray with nicotine early in spring.

Black Peach Aphid (*Anuraphis persicae-niger*)—A shiny black species, with reddish-brown nymphs, infesting roots, tender shoots, and fruits of peach, almond, apricots, or plums grafted on peach roots.

Spray foliage with nicotine sulfate, treat soil for root forms with paradichlorobenzene, as for peachtree borer.

Black Pecan Aphid—See **Hickory Leaf Aphid.**

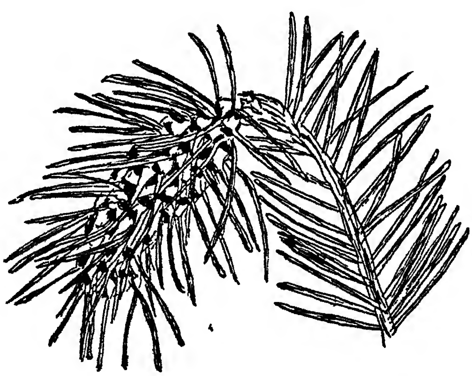
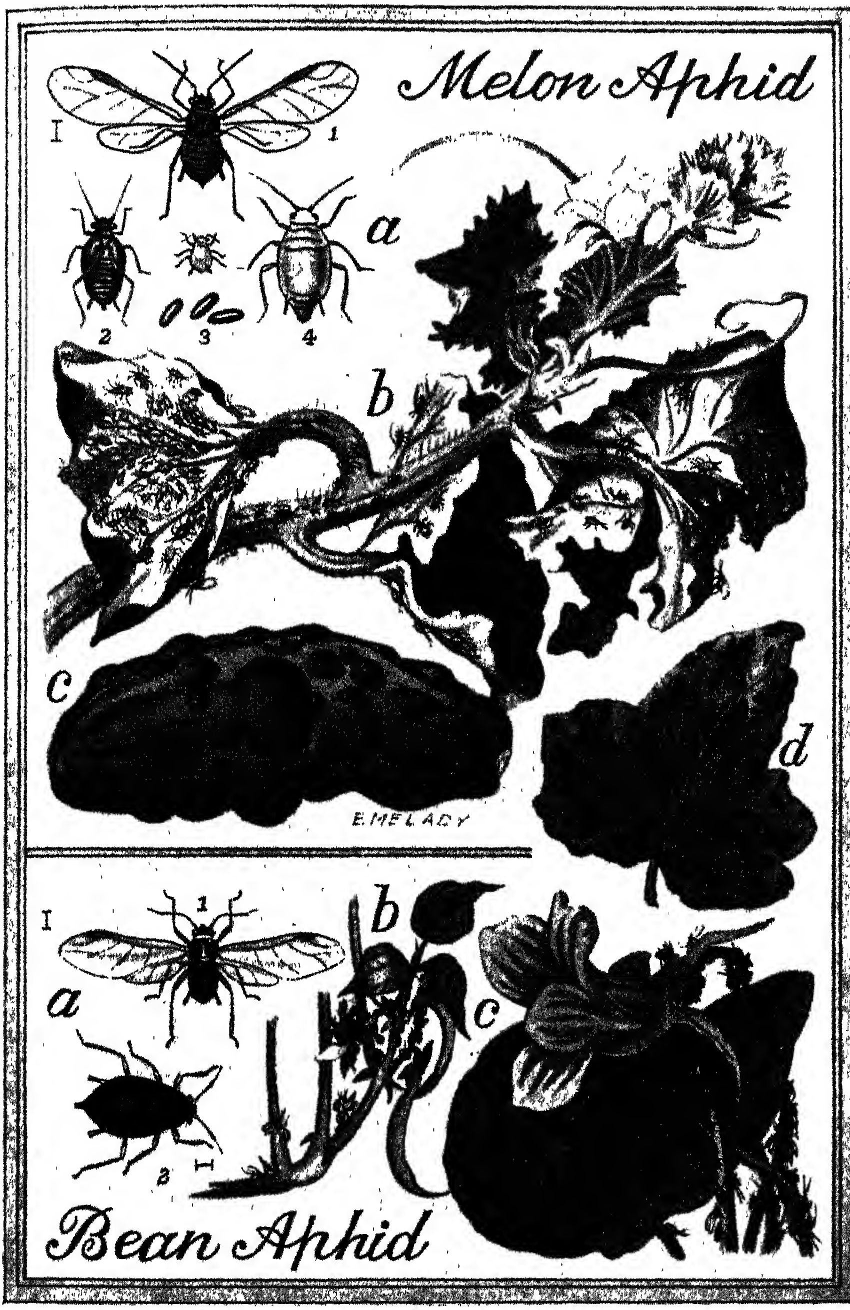


Figure 22

Aphid gall on blue spruce

Blue Spruce Gall Aphid (*Chermes cooleyi*)—Causes large terminal galls, 1 to 2 inches long, on Sitka, Colorado blue, and Engelmann's spruce, with Douglas fir as intermediate host. (Plate II, page 79; Figure 22.) The galls are formed both by enlargement and flattening of needles and by thickening of the stem. The color varies from light green to dark purple, changing to straw color after opening in July. Immature aphids winter near terminal buds, mature in spring, settle on foliage and envelop themselves in a mass of white cotton in which they lay eggs.

The young settle on new growth, causing the gall, made up of many chambers which open up in midsummer. The young then molt, acquire wings, and migrate to Douglas fir, starting egg-laying immediately in conspicuous nests of white wax. The eggs hatch in 7 to 10 days into dark



I **MELON APHID:** **(a)** 1, winged female, 2, last nymphal stage, 3, eggs and young nymph, 4, wingless female or stem-mother; **(b)** cantaloupe leaves starting to curl; **(c)** aphid-transmitted cucumber mosaic on fruit; **(d)** cucumber leaf mottled by mosaic virus. **BEAN APHID:** **(a)** 1, winged female, 2, wingless female; **(b)** aphids on bean; **(c)** clustering under nasturtium leaves.

II **APHIDS.** **(a)** Rosy Apple Aphid: 1, first generation; 2, summer aphid; 3, eggs (enlarged), eggs and newly hatched aphids on apple bud; 4, fall aphid, winged female; 5, fall aphid, winged male; 6, egg-laying female; 7, apples distorted, leaves curled. **(b)** Potato Aphid: injured potato leaves. **(c)** Woolly Apple Aphid: woolly masses on twig, galls on roots. **(d)** Melon Aphid: wingless form and curled foliage. **(e)** Eastern Spruce Gall Aphid: galls on Norway spruce. **(f)** Blue Spruce Gall Aphid: terminal gall on blue spruce. **(g)** Snowball Aphid: viburnum foliage curled, distorted.

green nymphs with a waxy fringe which remain on the underside of fir needles until spring. The females then lay eggs which hatch at the same time new growth starts on fir, the young causing some needle distortion as they feed on this host. Certain winged individuals are produced which migrate back to spruce, there to lay eggs in cottony masses on the needles, hatching into immature aphids which will winter on the buds. It thus takes 2 years for a complete life cycle of the blue spruce aphid.

The galls may weaken, stunt, very occasionally kill, spruce, and the aphids may cause Douglas fir needles to turn yellow and drop off.

Control. Do not interplant Sitka, Colorado blue, or Engelmann spruce with Douglas fir. Cut off and burn terminal galls before opening in summer. If necessary, apply a dormant oil spray at right dilution for evergreens (follow manufacturer's directions for dilution—usually 1 to 25 for miscible oils). This will take the bloom off spruce needles for a few weeks but should cause no other injury if the temperature is above 45° F. and does not drop below freezing for 24 hours after spraying.

Boxelder Aphid (*Periphyllus negundinis*)—A pale green, hairy species, present in the East and also in California, Colorado, and Utah.

Cabbage Aphid (*Brevicoryne brassicae*)—A whitish powdery or mealy species in colonies on leaves, causing them to curl. It attacks cabbage, cauliflower, Brussels sprouts, kohl-rabi, collards, kale, turnip, and radish. Seedlings may be killed, larger plants stunted. Dust with rotenone or nicotine.

Ceanothus Aphid (*Aphis ceanothi*)—Reddish-brown and black, infesting limbs, twigs, leaves of ceanothus and soapbush in California.

Chrysanthemum Aphid (*Macrosiphoniella sanborni*)—A large, shiny, dark brown or black species with short cornicles. It is very common in gardens, especially toward fall, but is readily controlled with any contact spray directed at the buds.

Clover Aphid (*Anuraphis bakeri*)—Principally a clover pest but with overwintering eggs on apple, pear, quince, or hawthorn. Stem mothers are pink or red; migrants and tree forms are yellow-green.

Columbine Aphid (*Myzus aquilegiae*)—Small green and pinkish species infesting wild and cultivated columbine.

Columbine Aphid (*Hyalopterus trirhoda*)—Small, flat, cream-colored species very abundant on leaves.

Common Birch Aphid (*Calaphis betulaecolens*)—Large green species with short cornicles densely infesting leaves of birch and producing copious honeydew followed by sooty mold. The eggs are laid in bark cracks and small crotches. The species is generally distributed.

Corn Leaf Aphid (*Aphis maidis*)—A small green or blue-green species, dense in the curl of the leaves and upper part of stalk, causing reddish-

yellow patches on leaves and coating tassels and silk with honeydew which interferes with pollination and attracts corn earworm moths. This species is more prevalent and destructive in the South, but may be found on corn and grains anywhere in the United States. There may be nine generations in Illinois, against fifty in Texas. Plant corn early; fertilize to hasten maturity.

Corn Root Aphid (*Anuraphis maidi-radicis*)—A serious pest east of the Rocky Mountains, dependent for its existence on ants, especially the little brown or cornfield ant. Roots of corn, cotton, grasses are often infested, the foliage taking on a yellowish tinge. Ants collect root aphid eggs in fall and store them in their nest over winter. In the spring the young are carried by their ant nurses to smartweed roots where the stem mothers mature and produce two or three generations of bluish-green small powdery aphids, with short legs, which are then transferred to roots of corn for ten to twenty generations. If migrant forms appear to fly to other cornfields they are seized by the ants who carry them back underground to feast on aphid honeydew.

Many ornamentals, especially aster, browallia, calendula, primrose, sweet pea, are infested with root aphids which turn them yellow and cause stunting, but these are probably the Aster Root Aphid, which see.

Cotton Aphid—See **Melon Aphid.**

Cowpea Aphid (*Aphis medicaginis*)—A black species with white legs; immature forms dark green or reddish-brown. This aphid, common in the Gulf states and the Southwest, feeds chiefly on legumes, but is also found on apple, bean, eucalyptus, opuntia, orange, pear, primrose, rhubarb, as well as grasses and weeds.

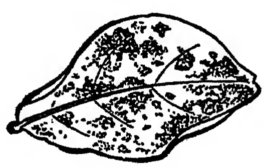


Figure 23

Sooty mold growing in aphid honeydew on crapemyrtle leaf

Crapemyrtle Aphid (*Myzocallis kahawaluokalani*)—Confined to crapemyrtle and serious wherever this southern shrub is grown. Copious honeydew encourages the fungus which covers the leaves with black, sooty growth. (Figure 23.) Spray early and thoroughly with any good contact insecticide.

Currant Aphid (*Capitophorus ribis*)—Pinkish, yellowish, or dark green, causing leaves to curl, crinkle, and hump up into half galls above the

portions where stem mothers are producing their numerous progeny. Such humped sections turn red, and leaves may drop. Currants and gooseberries are attacked throughout the United States and the species is recorded on deutzia and snowball. Glossy black eggs on twigs hatch into wingless females, which continue to reproduce parthenogenetically on currant while other winged females migrate to various weeds for the summer. The latter return to currant in the fall, producing the male and female generation and the overwintering eggs.

Figure 24

Currant leaf showing deformation by aphids

Control with a nicotine spray or dust early in the season, transferring to rotenone as the currants ripen. Be sure to reach the undersurface of cupped leaves. (Figure 24.)

Cypress Aphid (*Siphonatrophia cupressi*)—A rather large green aphid with a convex abdomen, infesting blue and Monterey cypress in southern California.

Dogwood Aphid (*Aphis cornifoliae*)—Brown, black, or dark green, sometimes powdery, common throughout the United States. It winters on dogwood and migrates to leaves of wild and cultivated sunflower for the summer.

Eastern Spruce Gall Aphid (*Chermes abietis*)—Causes cone-like or pineapple-shaped galls at base of new growth on Norway, white, black, Engelmann spruce. (Plate II, page 79; Figure 25.) Winter is passed as naked, immature greenish aphids in crevices about the bud scales. Early in spring these move out on the twig and complete their growth, secreting a white covering enveloping adult and eggs. The eggs hatch in 7 to 12 days and the young feed at the base of new growth, causing leaf bases to become enlarged into bulb-like hollows. Perhaps 50 of these cells will be

joined together to form the gall, each cell holding up to a dozen young aphids. New galls, ½ to 1 inch long, are green with the closed mouth of each cell marked with a red or purple line. They open in August (in New Jersey), releasing young aphids which develop wings at maturity but do not migrate. They lay eggs, 50 or so in a mass, on the needles. When the eggs hatch, in 5 or 6 days, the young seek winter quarters around the buds.

Figure 25

Aphid galls on Norway spruce

These galls not only retard growth and cause a marked decrease in vitality, but are most disfiguring. The galls turn brown after the aphids leave and infested branches often die back.

Control by cutting out galls where feasible, although this is not so easy as for the blue spruce galls; by spraying in spring before new growth starts with a miscible oil at the right dilution for evergreens, and by spraying in summer, after the galls have opened, with nicotine sulfate and soap.

Elm Cockscomb Gall Aphid (*Colopha ulmicola*)—Produces a series of elevations growing out of the leaf, green with red tips which look like cocks' combs. These galls, some ½ inch high by ¾ inch broad, are filled with plant lice which drip honeydew onto walks, people, and cars parked under trees. The winter is passed in the egg stage in bark crevices; the galls are formed in May and June. There is no feasible control.

European Birch Aphid (*Euceraphis betulae*)—Large green and black species with a waxy covering, infesting leaves of all kinds of birch throughout the country.

False Cabbage Aphid—See **Turnip Aphid.**

Fern Aphid (*Idiopterus nephrelepidis*)—Small, black species with

whitish legs and black clouded areas in wings. It infests ferns in houses and greenhouses and outdoors in California. Boston fern is a favorite. Spray with nicotine sulfate and soap, or dip the pots of ferns into the solution.

Forget-me-not Aphid (*Anuraphis myosotidis*)—Reported as common.

Foxglove Aphid (*Myzus pseudosolani*)—Common in the flower garden, infesting campanula, columbine, chrysanthemum, penstemon, physostegia, foxglove, gladiolus, lily, evening primrose, pansy, scarlet sage, verbena, and violet.

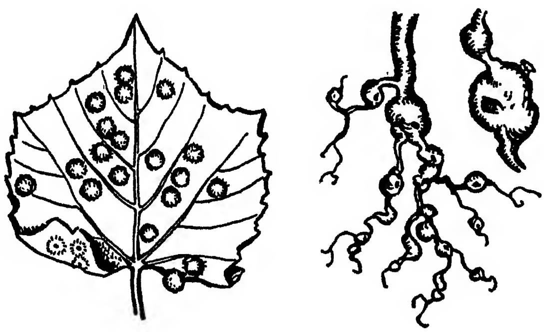


Figure 26

Grape Phylloxera, showing galls on leaf and roots, and root gall, enlarged

Geranium Aphid (*Macrosiphum cornelli*)—Found in greenhouses on several species of pelargonium.

Goldenglow Aphid (*Macrosiphum rudbeckiae*)—Practically inevitable on goldenglow, covering stems with bright red lice which, with their long legs, seem to stick straight out. Also infesting larkspur flowers and under-surface delphinium leaves. Spray with nicotine sulfate and repeat frequently.

Gooseberry Aphid (*Aphis grossulariae*)—A dark green and black powdery aphid recorded as abundant on tender gooseberry shoots in Oregon.

Grape Phylloxera (*Phylloxera vitifoliae*)—A common, injurious gall-forming species. (Figure 26.) A native of America, this aphid made history when it was introduced into Europe, nearly wrecking the grape industry in France and pursuing its devastating career in Italy and Germany. Even to the present day it is the most destructive grape pest in Europe and western United States, but seldom causes serious damage in eastern vineyards.

It reached France about 1860 and within 25 years had destroyed about 2,500,000 acres of vineyards, or one third the total. Grape is the only host.

The life history varies according to location. In the East young lice, hatching from overwintering eggs on canes, settle on upper surfaces of grape leaves, producing, by their feeding, galls on the underside. One female present in each gall becomes a stem mother, laying 400 to 600 eggs. Young greenish nymphs, hatching from the eggs in 7 to 10 days, migrate to form new galls on other leaves. Several such generations occur during the season, but about every third generation some of the aphids migrate to the roots where they form galls. There may be five or more generations of the root-gall type, but finally some of the root forms acquire wings and migrate to vines where they lay 2 kinds of eggs. The small eggs produce males; the larger eggs hatch into females. These are both wingless; they mate and each female now deposits a single overwintering egg, usually under the bark on 2-year-old wood.

In California vineyards leaf galls are rare and there may be no true male and female forms. Young nymphs pass the winter on grape roots, and during the growing season generations succeed each other on the roots, although sometimes winged migrants appear. Feeding roots are destroyed, often followed by death of vines.

The grape phylloxera is apparently a native of eastern United States and varieties grown here have acquired resistance to its attack.

Control. Quarantine regulations prevent movement of infested stock and most new vineyards are planted on land free from phylloxera. Cuttings or rootings should be dipped in hot water (122° F.) for 5 minutes before planting. The chief control in Europe and the West is the grafting of desirable varieties onto resistant rootstocks.

Grapevine Aphid (*Aphis illinoisensis*)—A blackish louse on grape shoots, viburnum, and cissus.

Green Bug (*Toxoptera graminum*)—A small green aphid of general distribution, causing an average loss of 1 to 3 per cent of the wheat crop, and in some years up to 25 per cent of the crop in the Southwest. Besides grains the green bug infests corn and other cultivated crops. It is of little account in New England but serious in states with large grain acreage. Injury from green bug depends on weather conditions, being worse in years with a mild winter and cool spring, since it reproduces most rapidly between 55° and 65° F. It is parasitized by a wasp whose reproductive activities cease below 65° F. In warm springs the aphid is held in check by the wasp; in cool springs it multiplies to enormous numbers.

Green Apple Aphid—See **Apple Aphid.**

Green Citrus Aphid—See **Spirea Aphid.**

Green Peach Aphid (*Myzus persicae*)—A most important pest, also known as **Spinach Aphid.** It is a general feeder on many plants, but most injurious to peaches, potatoes, and spinach. It has done upward of a

million dollars' worth of damage to the spinach crop in Virginia in a single year. It also attacks beet, celery, eggplant, lettuce, potato, tomato, members of the cabbage and cucumber families, a number of ornamentals, including aster, calendula, crocus, carnation, chrysanthemum, dahlia, dianthus, English ivy, forget-me-not, iris, lily, nasturtium, poppy, snapdragon, primrose, rose, tulip, verbena, violet, and several fruits—apricot, orange, peach, plum, prune, and cherry.

The green peach aphid is also dangerous as a disease vector, transmitting mosaic disease of sugar beets in the West; leaf roll of potatoes; tomato and tobacco mosaic.

The green peach aphid is a native of Europe, where it is often called greenfly, and is now distributed all over this country. Shiny black eggs winter on bark of fruit trees—peach, plum, apricot, cherry—hatching into pale, yellowish-green aphids with 3 dark lines on the back of the abdomen about the time peach trees come into bloom. They reproduce parthenogenetically with living young for two or three generations and suck sap from young twigs. Most of them then get wings and migrate to the garden plants in late spring. In autumn winged females return to peach and give birth to the true sexual females which mate with males flying over from spinach and other summer hosts, and then lay their eggs on the bark.

Control. The aphids on fruit trees can be controlled with nicotine sprays. Nicotine dust is recommended for commercial plantings of spinach, but as a home gardener you will probably prefer rotenone. If you don't dust, a little salt or vinegar in the wash water will help get the aphids off the spinach after harvest.

When growers have used calcium arsenate to control pepper weevils, green peach aphids have increased enough to injure the pepper crop severely—probably another case of killing aphid predators or parasites. Adding rotenone to calcium arsenate prevents this increase. In California a fungus kills many aphids on spinach and other hosts.

Hawthorn Aphid (*Anuraphis crataegifoliae*)—A pale or dark green aphid infesting underside of leaves of English hawthorn and some other thorns.

Hickory Aphid (*Longistigma caryae*), also called **Giant Aphid**—The largest species we have, and occurring only in trees—beech, chestnut, hickory, oak, pecan, sycamore, walnut, willow. Wingless forms are ash-gray with black spots on thorax; winged forms have all-black thorax. This aphid is seldom serious enough to call for control measures.

Hickory Leaf Aphid (*Melanocallis caryaefoliae*), also called **Black Pecan Aphid**—It causes serious injury in the South, where pecans are almost or completely defoliated by the end of the season, but seems to

have been nearly overlooked in the North as a cause of premature defoliation of hickory. Very small black lice cause orange spots in leaves, which turn brown and dead in a week or two. Thorough spraying with a contact insecticide is needed.

Honeysuckle Aphid (*Siphocoryne xylostei*)—A green aphid infesting Tartarian honeysuckle, snowberry, parsnip, and California laurel.

Hop Aphid (*Phorodon humili*)—Pale yellow-green in wingless, and green and black in winged state, with long curved cornicles. It winters in the egg stage on plum, prune, sometimes alder, peach, apple, and cherry. Spring nymphs may nearly cover underside of foliage of these trees before migrants fly to hops, or sometimes to sunflower, for the summer. A few stay on the winter host. Spray fruit trees in early spring with nicotine-soap solution.

Impatiens Aphid (*Macrosiphum impatientis*)—Sometimes troublesome on garden balsam (touch-me-not).

Iris Root Aphid—See **Tulip Bulb Aphid.**

Ivy Aphid (*Aphis hederae*)—A dark, purplish-green, brown, or black species common on growing tips of English ivy, also reported on *Euonymus europae, Viburnum opulis,* and aralia.

Laburnum Aphid (*Aphis laburni*)—Present on dwarf flowering locust or rose-acacia and also on golden-chain.

Lantana Aphid (*Cerataphis lataniae*) or **Palm Aphid**—Often mistaken for a whitefly in its wingless form, which is dark, disk-like, with a white fringe. Winged forms are dull brown or black. Besides lantana, it infests orchids in greenhouses, ferns, palms.

Leaf Curl Plum Aphid (*Anuraphis helichrysi*)—Pest of prune, plum in western states. The summer forms are green; the others, reddish. Fruit trees, winter hosts, may be seriously injured in spring. Summer hosts include aster, carrot, chrysanthemum, cineraria, dahlia, erigeron, eupatorium, heliotrope, marguerite, sunflower. Most injury occurs in Idaho and Colorado.

Lily Aphids (*Macrosiphum lilii, Myzus circumflexus*)—Two similar yellow and black species infesting undersides of lily leaves. The former is restricted to lily, the latter infests terminal buds and shoots not only of lilies but of many house, greenhouse, and outdoor plants. A partial list of hosts includes asparagus, anchusa, arabis, anemone, calendula, columbine, California laurel, ceanothus, cyclamen, foxglove, fuchsia, hydrangea, heliotrope, freesia, iris, myrtle, orchids, oxalis, penstemon, doronicum, rudbeckia, snowberry, stachys, violet, wallflower.

Linden Aphid (*Therioaphis tiliae*)—A yellow and black species with clouded wings, often very abundant on linden leaves. It has been introduced into the West from the East.

Lupine Aphid (*Macrosiphum albifrons*)—A large green species entirely covered with white powdery wax, with long legs and cornicles. It infests tips of annual and perennial lupines in California in spring and early summer.

Manzanita Leaf-gall Aphid (*Tamalia coweni*)—Dark green and black, producing numerous green or reddish roll galls on edges of manzanita leaves in Colorado, Nevada, California.

Maple Aphid (*Drepanaphis acerifolii*)—Gray and black in winged form, yellow in wingless stage, infesting leaves of sugar and silver maples.

Mealy Plum Aphid (*Hyalopterus arundinis*)—An alternate-host species, wintering in the egg stage at base of buds on plum and prune twigs, and migrating to reed grass or cattails. This is a pale green aphid with a mealy or powdery coating, a native of Europe, and especially important in the West. It may infest apple, apricot, and peach, as well as plum. It curls foliage, causes general stunting, fruit splitting, and spoilage by excrement and sooty mold.

Control. Japanese hybrid plums are said to be immune. Spray with dinitro-o-cyclohexylphenol (Dow Dormant) in winter when plants are dormant, using a 1 to 50 dilution; or with sodium dinitro-o-cresolate (Elgetol); or in spring, when aphids are on leaves, with a summer oil plus nicotine.

Melon Aphid (*Aphis gossypii*)—A common pest of cucumbers, melons, and squashes everywhere, serious on cotton in the South, where it is known as the Cotton Aphid, and an important pest of citrus trees in Florida and California, where it is often called the orange aphid. It is distributed throughout the United States, although most serious in the South and Southwest; is common in the greenhouse as well as outdoors; and is often considered the most destructive aphid in the United States.

The melon aphid is very cosmopolitan in its tastes; records show that it feeds on at least 46 plant species in Maine and 64 in Florida. A partial list adds to the cucurbit, cotton, and citrus groups: asparagus, aster, avocado, begonia, buckthorn, California poppy, catalpa, chrysanthemum, cineraria, citron, cyclamen, dogwood, German ivy, gourd, hydrangea, ironwood, lily, nemesia, okra, pomegranate, rose, sunflower, strawberry, syringa, thistle, verbena; also bean, beet, eggplant, spinach, and many weeds such as shepherdspurse, peppergrass, pigweed, and dock.

The melon aphid is small, usually very dark green but varying to yellowish-green, brown, or black. It winters in the North in the egg stage on live-forever; but in the South living young are produced through the year, as many as fifty-one generations having been recorded, with the average young per female more than eighty. When the aphids get too crowded, winged forms develop to start a new colony at another location.

The first sign of aphid infestation in the melon or cucumber patch is the wilting and curling of leaves (Plate I, page 78) accompanied by visits of ants, bees, wasps, and flies to get the honeydew. This aphid is also a carrier of cucumber and melon mosaic, a strain of which is responsible for the serious mosaic disease of lilies. On cucurbits, the mosaic shows as mottled dark and light green foliage and stunting of vines.

In Florida the melon aphid is the most serious watermelon pest, large commercial acreages often being destroyed before melons can be shipped. On orange, grapefruit, and other citrus trees the aphids infest young twigs, curling and distorting them.

Control. The melon aphid is difficult to control after the leaves and tender tips start curling. Three per cent nicotine dust seems most effective and somewhat less likely to kill natural enemies than some other chemicals. A nicotine spray can be used if forced into curled tips.

In most years natural parasites or predators are very efficient in keeping down the numbers of melon aphids. Formerly the State Horticultural Commission in California sent out large quantities of the lady beetle (*Hippodamia convergens*). Dr. Lutz quotes a letter written in 1910 saying that they had over a ton of these predators in cold storage, destined for melon growers in the Imperial Valley. Other predators are syrphid fly and aphid-lion larvae. In the North, melon aphids are most destructive in a hot, dry summer following a cool, wet spring which reduces the natural enemy population.

Monterey Pine Aphid (*Essigella californica*)—A slender green species with very long legs, infesting needles of Monterey pine in California, reported on yellow pine and Douglas fir in Oregon, white pine in Maine.

Myrtle Aphid (*Rhopalosiphoninus latysiphon*)—A green species with swollen cornicles feeding, at least in California, on tender tips of chrysanthemum, myrtle (Vinca), Shasta daisy, morning glory, and potato; reported also on primula and viola.

Norway-maple Aphid (*Periphyllus lyropictus*)—A nuisance to large numbers of people, most of whom have never seen or heard of it. This is a large, hairy green to brown aphid infesting underside of Norway maple foliage through the summer and dropping copious quantities of honeydew down to smear windshields and bodies of cars parked under street trees with minute sticky drops very difficult to clean off. Heavy aphid infestations may be followed by a heavy summer leaf drop. Spray street trees with nicotine sulfate and soap early in summer, wetting underside of leaves thoroughly.

Oleander Aphid (*Aphis nerii*)—A pretty yellow-and-black species, common in Florida and California and occurring in other states. It ap-

pears in spring on young oleander shoots and later migrates to milkweed, although in a few cases it stays on oleander the entire year.

Palm Aphid—See **Lantana Aphid.**

Pea Aphid (*Macrosiphum pisi*)—A smooth green species, generally distributed but of special importance to large growers and the pea-canning industry. It arrived here about 1870. In large pea fields aphids may be so abundant that plants and ground look white from cast skins; vines wilt and die. Even when less abundant, the quality of the peas is affected. The pea aphid is limited to legumes—garden and field peas, clover, sweet clover, and alfalfa.

Control. Rotenone dusts are the usual control measures, but DDT applied in aerosol form offers possibilities for the large grower. Some pea varieties are resistant to attack, but the pea aphid is a complex species made up of several biological races, so that maintaining plant resistance is difficult. The pea aphid has 50 to 100 young per female, and seven to ten generations in a season; it would increase to incredible numbers were it not for the many natural parasites and predators.

Pine Bark Aphid (*Pineus strobi*)—A common home pest, restricted to pine, preferring northern white pine but also infesting Scotch and Austrian pines. It congregates in conspicuous white, flocculent colonies on underside of large limbs or on main trunk, giving a whitewashed appearance.

The immature aphids winter under the white felty masses or under the bark, maturing and laying eggs in April or May, from which come both winged and wingless forms. Most of the former migrate to other pines; the latter lay eggs for a brood of adults appearing in August and September whose young are the hibernating nymphs. This bark aphid is not a problem on mature trees in natural stands, but may injure unthrifty young trees in ornamental plantings and be unsightly on older trees.

Control. Spray bark before growth starts with a miscible oil, at a 1 to 25 dilution, or following manufacturer's directions for evergreens; or use a 1 to 10 dilution of lime-sulfur (on bark only). After new growth starts, nicotine sulfate and soap applied with enough pressure to break through the felty coverings will be helpful.

Pine Leaf Aphid (*Pineus pinifoliae*)—On northern white pine as the alternate host for black, red, and Engelmann spruce where it makes compact terminal galls. Another species (*P. floccus*) migrates from galls on red and black spruce to needles of eastern white pine where they appear rather woolly, due to the secretion of white waxy coating.

Control. Spray the needles with nicotine sulfate and soap when aphids appear; pick terminal galls off spruce; and if necessary use a dormant oil spray before new growth starts.

Poinsettia Root Aphid (*Pemphigus* sp.)—A yellowish-green, cottony aphid reported infesting large plants in a greenhouse after potting. Loosening the earth ball in the pot and submerging pot and soil in a solution of Black Leaf 40 (1 tablespoon plus 1 ounce laundry soap to 1 gallon of water) previously heated to 110° F. gave good results.

Poplar Leaf Aphids—A number of species may be present on leaves of poplar and cottonwood, but are not important enough to discuss separately. They may be controlled, when necessary, with nicotine sulfate and soap.

Poplar Stem Gall Aphid (*Pemphigus populicaulis*)—widely distributed. It forms globular galls at base of leaf petioles. Stem mothers are yellow or green; winged forms dark, partly covered with white wax.

Poplar Vagabond Aphid (*Mordwilkoja vagabunda*)—Winters on cottonwood, poplar, and aspen, living in imperfect rosette-like galls on the leaves, then migrating to unknown summer hosts.

Potato Aphid (*Macrosiphum solanifolii*)—Often called pink and green aphid. (Plate II, page 79.) It is commonly present throughout the United States on many plants. Years of great abundance, when the aphid is present in almost epidemic proportions, are followed by lean years. The potato aphid is as destructive as a vector of mosaic and other virus diseases of potato and tomato as it is for the injuries it causes by its feeding.

Rose is the winter host, except in warm climates like California. Black eggs on rose canes hatch into glistening pink and green lice, wingless, with long cornicles, which feed on succulent rosebuds and young leaves. In early summer winged forms develop to fly to potatoes and other summer hosts, while other wingless forms crawl to their new plants.

Besides potato and rose this aphid commonly infests apple, asparagus, aster, bean, cineraria, citrus, corn, eggplant, fuchsia, gladiolus, ground-cherry, iris, Jerusalem-cherry, oxalis, pea, pepper, sunflower, sweet potato, tomato, turnip, and many weeds.

Potato foliage is curled and distorted by aphid feeding; the vines often turn brown and die. On tomatoes the blossom clusters are so devitalized that no fruit is set. Generations develop every 2 or 3 weeks, with vines rapidly covered with lice. On a single tomato plant 24,688 aphids were once counted. In September and October aphids return to roses, there to produce the egg-laying females which mate with males flying over from summer hosts.

Control. Spray thoroughly with nicotine sulfate, 1½ teaspoons plus 1 ounce of soap per gallon of water, repeating at frequent intervals. Or use nicotine dust. For flowering plants pyrethrum or other contact insecticides can be substituted.

Raspberry Aphids (*Aphis rubicola* and *Nectarosiphon rubi*)—Found

in small numbers on underside of leaves of raspberry. They are more important as vectors of mosaic than for direct injury.

Red Cedar Aphid (*Lachnus sabinae*)—A small, reddish-brown aphid with a thin, waxy coat closely resembling bark of red cedar which it may infest in large numbers. The aphid feeds on new growth in spring, checking growth, and secretes much honeydew. The leaves are coated with sooty mold growing in the sweet medium and the pores are choked. Trees may be so weakened that they succumb to attacks of the red cedar bark beetle. Spray promptly with nicotine sulfate and soap.

Red Violet Aphid (*Neotoxoptera violae*)—Wine-red with clouded wing veins, infesting young shoots, buds, and leaves of outdoor violets in California; present in greenhouses in other parts of the country.

Rhododendron Aphid (*Macrosiphum rhododendri*)—Pink and green species infesting this host in Oregon.

Rose Aphid (*Macrosiphum rosae*)—A large species feeding on tender buds, with pink and green forms resembling those of the potato aphid. It is, however, a single-host species, continuing to breed on roses through the season. It has several common predators and parasites. When the dragon-like larvae of ladybeetles or slug-like aphid lions are at work it is sometimes better to stop spraying temporarily and give the beneficial insects a chance. Nicotine sulfate, pyrethrum, and rotenone are all satisfactory for aphid control on roses and usually may be combined in a spray or dust aimed at other insects as well.

A small green aphid (*Myzaphis rosarum*) is also a serious rose pest on occasion. It is much smaller than the rose aphid, has no pink forms, is found anywhere on the plant, and is not restricted to succulent growth.

Rosy Apple Aphid (*Anuraphis roseus*)—An important apple pest. (Plate II, page 79.) It causes the leaves to curl and deforms young fruit, producing "aphis apples." It is present throughout the United States in apple-growing sections and may also feed on pear, thorns, and mountain ash. It winters as dark green, shiny eggs attached to twigs or in bark crevices, hatching over a period of 2 weeks when buds are opening. The stem mothers, purplish or rose with a waxy coating, feed on outside of buds until leaves start to unfold, then work their way down into the cluster. When their sucking proclivities curl up the leaves they are well protected from natural enemies, sprays, and dusts.

Stem mothers continue to produce living young through the spring and early summer, but finally winged migrants, the same color, except with black head and thorax, go to feed on stems of narrow-leaved plantain. Later generations return to apple in autumn.

Control. Efforts are best directed at overwintering eggs by using a dormant spray of lime-sulfur, or oil, or oil plus one of the dinitro com-

pounds. After the buds have broken out, nicotine can be added to the regular apple sprays, or a special application of nicotine sulfate and soap can be made. After the leaves are half open and starting to curl, nicotine dust is more effective. Ladybeetles, syrphid fly larvae, and aphid lions all help to control rosy apple aphids in warm seasons, but when the weather is cold and wet, unfavorable for rapid development of the predators, the aphids get the upper hand unless man steps in.

Rusty Plum Aphid (*Hysteroneura setariae*)—A rusty brown aphid common on plums in the East and west to Colorado. It also feeds on corn, grasses, sugar cane, and Virginia creeper. Control with nicotine sulfate and soap when aphids appear, or a dormant spray against the eggs.

Figure 27

Snowball leaves curled by aphids

Snowball Aphid (*Anuraphis viburnicola*)—Cause of the familiar curling and deforming of leaves of the common snowball (*Viburnum opulus*) in early spring. (Plate II, page 79; Figure 27.) The aphids vary in color from ashy-gray to dark green and start curling the leaves long before they are fully out. Control is difficult because the lice are protected almost from the beginning inside the curled portions. A dormant-oil spray followed by frequent applications of nicotine sulfate and soap will be helpful, but not entirely effective. A nicotine dust helps a little. Removing infested shoots at least improves the appearance of the bush unless the infestation is too general. Replacement of the common snowball with *Viburnum tomentosum*, resistant to aphid injury, is an easier solution than continual spraying with less than mediocre results.

Snowberry Aphid (*Aphis symphoricarpi*)—Sometimes infesting snowberry in the East. Another species (*A. albipes*) is a gray louse feeding on snowberry leaves in California and Colorado.

Spinach Aphid—See **Green Peach Aphid.**

Spirea Aphid (*Aphis spiraecola*)—Another important pest with far-reaching influence. It is a common species on spirea, covering new growth in early summer with myriads of green lice, much like the apple aphid, its close relative. Its career, as the green citrus aphid, is relatively recent, having been noticed in Florida for the first time in 1923 but not distinguished from the melon aphid until the next year. In California, too, it was thought to be the melon aphid until 1926. In addition to spirea and citrus plants this species attacks Japanese quince, haw, apple, pear, cherry-laurel, and a number of herbs.

The eggs and sexual forms appear on spirea; the parthenogenetic, viviparous forms on citrus and other hosts, where the life cycle is only 6 to 10 days, with possibilities of large populations built up by many generations. Newly planted trees suffer most.

Control. Spray with nicotine sulfate, or apply 10 per cent nicotine dust.

Spruce Aphid (*Aphis abietina*)—A small green aphid on older needles of Norway and Sitka spruce in spring and early summer. Needles turn yellow and fall. This species is present on the West coast; alternate summer hosts are not known.

Strawberry Aphid (*Capitophorus fragaefolii*)—A small, pale yellow species occurring in dense populations on strawberry leaves or on stems in the crown of the plant. This aphid transmits a serious strawberry disease known as xanthosis or yellows or crinkle. It winters in the egg stage on strawberry and potentilla.

Control. Dust with 4 per cent nicotine dust for aphid; to control the disease, use only certified planting stock.

Strawberry Root Aphid (*Aphis forbesi*)—A single-host aphid on strawberries east of the Rockies and particularly injurious in New Jersey, Delaware, and Maryland. Black shiny eggs, overwintered on leaves and stems, hatch in early spring into dark, bluish-green aphids which feed on new leaves. They are found there by the little brown cornfield ant and carried to strawberry roots where they feed on root sap. There several generations keep the ants in honeydew, but in the fall winged forms go to the leaves and give birth to sexual males and females which mate and provide overwintering eggs. In mild winters the root forms also persist.

There is little to be done in control except to select uninfested plants for new beds, preferably certified plants, and to cultivate the ground in early spring deeply and thoroughly.

Sunflower Aphid—See **Dogwood Aphid.**

Sycamore Aphid (*Drepanosiphum platanoides*)—A common large green or reddish aphid infesting maples and sycamores.

Thistle Aphid (*Anuraphis cardui*)—A large, shiny green species sum-

mering on thistles, chrysanthemum, and weeds; wintering on apricot, plum, prune.

Tulip Bulb Aphid (*Anuraphis tulipae*), often called **Iris Root Aphid**—A whitish, powdery species with black head and thorax in the winged forms. It infests bases of plants at or below surface of ground and seeks hiding places in flower stems, under leaf sheaths, or in seed pods. It attacks all varieties of bearded and beardless iris and continues to feed on stored rhizomes, as well as tulip and other bulbs. It is often present in quantity on stored gladiolus corms. Treatment in the garden is seldom necessary, but crowns of plants can be dusted with nicotine if need be. Infested bulbs and corms should be soaked in nicotine sulfate and soap, or pyrethrum solution, for a half-hour before planting.

Tuliptree Aphid (*Macrosiphum liriodendri*)—A small, green species abundant on underside of leaves and secreting copious quantities of honeydew. Leaves of the tulip trees, and often leaves of rhododendron and other broad-leaved evergreens growing underneath or near by, are densely coated with black soot from the fungus growing in honeydew.

Turnip or False Cabbage Aphid (*Rhopalosiphum pseudobrassicae*)—A greenish species covered with white bloom like the common cabbage aphid. Host plants are cabbage, cauliflower, collards, kale, kohl-rabi, mustard, radish, rape, rutabaga, turnip, bean, lettuce. It occurs anywhere in the United States, being particularly abundant in the Gulf states, where it continues to reproduce during the winter. Derris or nicotine dusts are recommended for control, and DDT has given promise in recent experiments.

Violet Aphid (*Mycromyzus violae*)—A black aphid common on violets, especially in greenhouses.

Walnut Aphid (*Chromaphis juglandicola*)—A small, pale yellow aphid common on English walnut throughout California and Oregon. Feeding on undersides of leaves, it injures both by extracting sap and by the sooty mold growing in its honeydew. Nicotine lime dust or nicotine-sulfate sprays give control if applied early in the season, before ladybeetles and other natural enemies are abundant. A late application of poison kills the predators and allows the aphid population to increase. Many aphids are killed by a fungus.

Waterlily Aphid (*Rhopalosiphum nymphaeae*)—Small, varying from dull to shiny green or black on its summer hosts—waterlily, water plantain, cattail, pondweed, knotweed. On its winter fruit-tree hosts—almond, apricot, plum—it is larger, reddish-brown, covered with white powder. It is also reported as seriously injuring Japanese cherry when this is grown near waterlily ponds.

Use nicotine-sulfate sprays on trees, pyrethrum on waterlilies which

may have both flowers and leaves infested. Do not use rotenone for control near fish.

Woolly Alder Aphid (*Prociphilus tessellatus*), also called **Alder Blight Aphid** or **Maple Leaf Aphid**—Widely distributed. Maple is usually considered the primary, and alder the secondary, host. Branches of alder or leaves of maple are covered with masses of white cottony material covering blue-black aphids. In early fall male and female aphids, the latter small and orange, are produced on alder and go back to maple to mate and lay eggs on maple bark. At the same time a wingless hibernating form is produced on alder, and this crawls down the trunk to spend the winter under leaves on the ground. In New York, migration from maple to alder takes place in August and the return trip in September or October.

Ladybeetles and the caterpillar of an orange butterfly feed on these aphids, but one species of ant tries to protect them in exchange for honeydew. Not usually important enough to warrant other control measures, the aphids can, if desired, be destroyed by repeated applications of nicotine sulfate and soap.

Woolly Apple Aphid (*Eriosoma lanigerum*)—Of world-wide distribution wherever apples are grown. It also attacks pear, hawthorn, mountain-ash, and elm. It covers trunk and branches with white cottony masses enclosing purplish lice, and forms knots on the roots, causing many fibrous roots, stunting, and sometimes death of young apple trees. (Plate II, page 79.)

The life history is complicated. The woolly apple aphid winters in several forms—as eggs on bark of elm trees, as immature nymphs on apple roots, or, in warm climates, as egg-laying females on apple bark. The eggs on elm hatch early in spring into wingless forms which feed on elm buds for two generations, turning the young leaves into curled rosettes which protect the purplish aphids with their powdery coatings.

The next generation has wings and migrates to apple, hawthorn, and mountain-ash, where some of the lice feed in wounds on trunk and branches and others work their way down to the roots where the most important injury is produced. In autumn some winged migrants return to elm, while other wingless aphids remain to produce living young on apple roots.

Control. Plant clean nursery stock; dip infested seedlings in strong nicotine-sulfate solution before planting. Spray as for other apple aphids to kill lice on trunk and branches. Cultivate and fertilize to keep apples growing vigorously. A wasp-like parasite, *Aphelinus mali,* is an important enemy of this aphid and has been sent to many countries.

Woolly Beech Aphid (*Phyllaphis fagi*)—Common on the underside of leaves of purple beech. This is a greenish species covered with promi-

nent white waxy threads which look like trailing cotton robes. Ordinarily control measures are unnecessary, but nicotine sulfate, directed with high pressure from underneath the trees, will clean up a really bad infestation.

Woolly Elm Aphid (*Eriosoma americanum*), or **Elm Gall**—Much like the woolly apple aphid, producing curled or rolled leaves but no rosettes on American elm. The alternate host is shadbush or serviceberry. Another species (*E. ulmi*) produces a similar leaf roll on English elm.

Woolly Hawthorn Aphid (*Eriosoma crataegi*)—Much like the woolly apple aphid with which it has been confused. It does not produce galls on roots, but it is parasitized by the same wasp.

Woolly Honeysuckle Aphid (*Prociphilus xylostei*)—Occurs in colonies and twigs and in curled leaves of this host.

Woolly Larch Aphid (*Chermes strobilobius*)—Common and conspicuous on larches in May and June, having overwintered as immature nymphs on bark of this host. Some of the woolly white larch aphids migrate to pine, where egg-laying forms are produced, the eggs hatching the next spring. In August some aphids migrate back to larch, there to hibernate in bark crevices. The life cycle takes 2 years. Spray *before growth starts* with a dormant oil for evergreens; or later in the season with nicotine sulfate and soap.

Woolly Pear Aphid (*Eriosoma pyricola*)—Also similar to the woolly apple aphid and for a long time considered the same. It is established on the Pacific coast and in limited locations farther east. Its life cycle is completed on elm, where it produces leaf galls.

Armadillos—See **Mammals.**

ARMYWORMS

Armyworms are caterpillars, larvae of moths, and related to cutworms. They are probably more injurious in the Middle West than in the East, and to fields rather than to small vegetable garden crops. Control is generally by use of baits. See Baits, under Garden Chemicals, Chapter II.

Armyworm (*Cirphis unipuncta*)—Common from the Rocky Mountains eastward, traveling in dense armies, devouring all crops along the line of march. It fluctuates in importance, reaching epidemic numbers at varying intervals of years. The worms are dark green, up to 2 inches long, with white stripes down the sides and middle of the back. They winter mainly as larvae, then form dark brown pupae in the soil, whence emerge brown or grayish moths with a small white dot in the center of each front wing; 1½ inches across the wings. The moths fly at night, and

are attracted to lights and decaying fruits. The females lay greenish-white eggs in long rows on lower leaves of grasses. There may be two or three generations a year, with the first most injurious.

Outbreaks are usually controlled by scattering poison bran mash bait as for cutworms, either in the field they are working or across the line of march to intercept them when they have devoured one field and are en route to the next. Deep furrows with a fine dust mulch made by dragging a log along the bottom will stop migrating armies. Many insects, especially tachinid flies, are parasitic on the caterpillars.

Beet Armyworm (*Laphygma exigua*)—One of the more common western armyworms. The larvae are green above, yellow underneath, with a dark stripe on the back and yellowish stripes on each side. They eat tops and roots of sugar beets, feed on cereal, field, and truck crops. The eggs are pinkish, covered with a white cottony material; adults are mottled gray. This species is also known as the **Asparagus Fern Caterpillar.**

Fall Armyworm (*Laphygma frugiperda*)—So named because it does not appear before fall in the northern states. It is a tropical insect wintering in southern Florida and along the Gulf coast, and migrating north in summer as far as New England and Michigan. Called the southern grassworm in Florida, it eats all grass in easy range before moving to corn, its second choice. On corn it is sometimes called budworm and it works something like the corn earworm. It is particularly injurious following a cold, wet spring. Besides corn and grasses, the fall armyworm attacks clover and grain crops, bean, cabbage, cowpea, cucumber, peanut, potato, sweet potato, spinach, tomato, turnip.

The moths, 1½ inches across with grayish-white hind wings, dark gray mottled fore wings, and a white spot near the tip, fly northward in swarms, mostly at night. They lay up to 1,000 eggs, in clusters of about 150 each, on green plants. The young larvae start feeding near the ground and do a lot of damage before they are noticed. They are light tan to green or black, with 3 yellowish hairlines down the back, then a darker stripe next to a waxy yellow stripe splotched with red. They have a conspicuous V-shaped white mark on the head.

When they have eaten all the food in one garden they start on a forced march to the next. Only one generation is abundant in the North; there may be five or six in the South.

Control. Use same measures as for true armyworms, and cultivate soil to break up pupae and expose them to natural parasites. Young corn and some other crops can be sprayed with lead arsenate.

Southern Armyworm (*Prodenia eridania*), also called **Semi-tropical Armyworm**—This species is prevalent in Florida and has been noted as

far north as South Carolina. It is a major pest of celery and sweet potato, attacks cotton, and some other plants. The larvae are black, or yellow with black markings.

Yellow-striped Armyworm (*Prodenia ornithogalli*), also known as **Sweet-potato Caterpillar** or **Cotton Cutworm**—This is a sweet-potato pest in Florida, often defoliating whole fields in July and August. In California and southwestern states it infests truck and field crops, flowers, fruits, forest and shade trees.

The caterpillars are day-feeding, olive-green to brown, with a double row of green or black spots on the back and usually a bright orange stripe outside the spots. The moths have mottled gray or brown fore wings, pale hind wings.

Use poison bait or dust plants with 1 part lead or calcium arsenate to 3 of hydrated lime.

BAGWORMS

Bagworms are caterpillars which carry their bag-like houses around with them. They are larvae of moths, family Psychidae, with legs practically absent, and females rarely leaving cocoons. Of the 20 species in this country, 1, often known as the evergreen bagworm, is especially common.

Bagworm (*Thyridopteryx ephemeraeformis*)—Distributed from Massachusetts south to Florida and west to Texas. It is a general feeder, attacking nearly all trees, and sometimes defoliating willows, Norway and soft maples, sycamores, locusts, boxelders, and lindens, but especially injurious to arborvitae, cedar, and other ornamental evergreens and sometimes to pine, hemlock, and larch. I have seen miles of red cedar in Virginia killed with bagworms, but never such total destruction in my own state of New Jersey.

The spindle-shaped bag, 1 to 2 inches long, unbelievably tough when you try to tear it, is covered with bits of leaves and twigs from its host plant, a bag hanging on a juniper looking quite different from one made on a pine. See Plate III, page 110.

The female moth, which looks much like the larva, being soft, almost legless, black with the fore part spotted black and white, lays her eggs inside the bag in early autumn. They hatch in late spring, each young larva crawling out of the bag, feeding on near-by leaves, and starting to build a new bag for itself, making it bigger as needed to accommodate its own increase in size. The caterpillars take their bags with them as they move around, fastening them to twigs with a bit of silk as they stop to feed. They pass through 4 molts and pupate in late summer.

The male moths have soft, black furry bodies with 4 nearly transparent wings. They desert their bags, smaller than those of the females, mate inside the female bag, and then die. The female deposits a mass of 500 or more eggs in the upper part of her bag, tamps scales from her body into the lower portion of the bag, and then she, too, dies. There is only one generation a year.

Control. When there is a light infestation, picking off the bags is the easiest method of control. This can be done in winter when there are not so many other garden chores. As soon as young caterpillars start crawling around, spray trees or shrubs with lead arsenate, using 3 to 4 level tablespoons per gallon, plus 1 teaspoon of nicotine sulfate. The bagworm has several hymenopterous parasites, and sometimes sapsuckers and woodpeckers are able to tear open the bags for the succulent morsels within.

Orange Bagworm (*Platoeceticus gloverii*)—Sometimes recorded as injuring orange fruit and twigs, making bags of leaves, bark, moss, and remains of scale insects.

Tornillo Bagworm (*Oiketicus townsendi*)—Commonly found in New Mexico and Arizona on apple, ash, locust, pear, sycamore, willow. A similar species occurs in southern California.

BEES

Bees are tremendously important in the garden, especially in the orchard, for pollination. Apples rarely set unless they are fertilized with pollen from some other variety. Honeybees accomplish about 90 per cent of the pollen transfer in the apple orchard, but bumblebees, solitary bees, and syrphid flies are also helpful. Pears, cherries, plums, peaches, strawberries, and some vegetables need insect help for a good crop, or to set seed. Commercial orchardists frequently rent hives of bees for the flowering period.

Much has been written recently about the effect of DDT on bees. Many people, apparently, have never stopped to think that lead arsenate, cryolite, and other stomach poisons also kill bees and that that is one reason why a fruit-spray schedule is so carefully timed. The pre-pink spray is put on before the blossoms open, and the calyx spray is applied when most of the petals have fallen. *No poison spray should be used while the bees are coming to the flowers for nectar.*

Leaf-cutter Bees (*Megachile* spp.)—Nest in tunnels in wood. The female cuts from foliage, usually rose leaves, perfect ovals to line the bottom and sides of her nest; and then cuts, with the same precision, a circle to make a cap after her egg is laid. (Figure 28.) Then she cuts

more ovals from the edge of leaves to start another cell on top of the first. Although rose foliage, especially in late summer, may bear much evidence that the leaf-cutter bee has been working, no control measures are suggested.

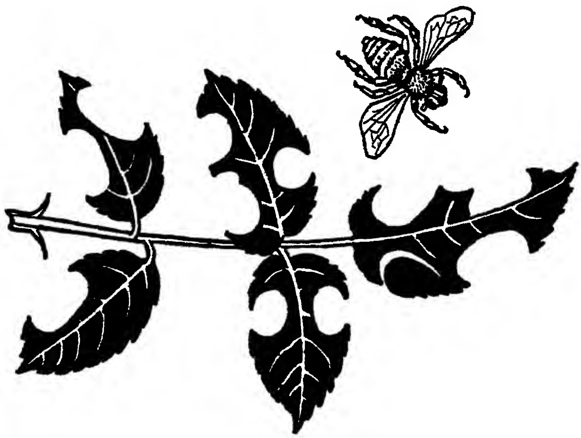


Figure 28

Leafcutter bee and its work on rose

BEETLES

Beetles belong to the order Coleoptera, a word which means "sheath wings." This is the largest insect order, with more than 250,000 species already recorded, of which about 24,000 are in North America north of Mexico. Some beetles are predaceous, preying on other insects and hence helpful to us; some beetles are scavengers, cleaning up rotting animal and plant refuse; but many beetles feed on healthy plant tissues and so become our enemies. They are doubly injurious because both larvae and adults have chewing mouth parts.

The chief characteristic of the order Coleoptera is the modification of the first pair of wings into hard, horny sheaths, technically known as elytra (Figure 29) and commonly called wing covers. Except in the blister beetles, the elytra meet in a straight line down the back. Membranous hind wings are folded under the elytra except in actual flight. Some running ground beetles, and some weevils which cannot fly, lack the second wings and have the horny elytra grown together over the back.

Beetles have complete metamorphosis, the larval stage being totally unlike the adult. The egg hatches into a soft grub, usually with 6 legs but occasionally legless, which then enters a pupal stage, the pupae

differing from those of moths by having limbs and wing pads free, and finally transforms into the adult form—the beetle. (See Figure 14, Chapter IV, for a diagram of insect metamorphosis.)

There are more than 110 beetle families in North America. A few of them are in the suborder Adephaga, which means voracious and includes the predaceous species, but most families are in the suborder Polyphaga.

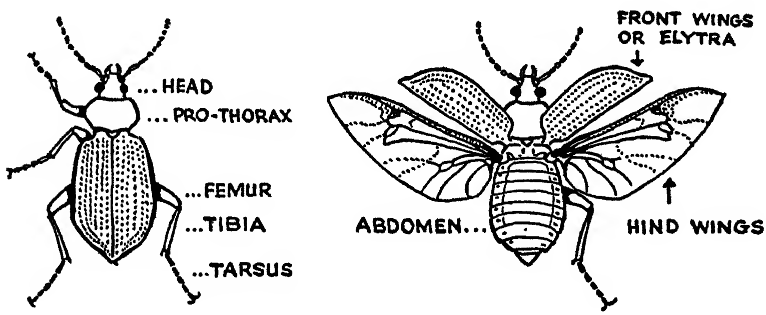


Figure 29

Diagram of beetle with wings in normal position and spread for flight

The beetle families are divided by many technical taxonomic characters, such as the structure of the antennae, form of legs, number of tarsal segments, and the way the body is put together; but the families of special interest to gardeners fall into rather familiar groupings:

Suborder Adephaga—Predaceous or carnivorous beetles; legs of larvae are 6-jointed and have 2 claws.

Family Cincindelidae—Tiger beetles; beautifully colored adults with ugly larvae, waiting in burrows for prey.

Carabidae—Ground beetles; common on surface of ground, lurking under stones and rubbish; garden friends.

Suborder Polyphaga—Having no more than 5 leg segments, 1 claw.

Family Lampyridae—Fireflies, feeding at night on slugs, cutworms; comparatively soft beetles.

Meloidae—Blister beetles.

Elateridae—Click beetles, adults of wireworms.

Buprestidae—Metallic wood borers.

Coccinellidae—Ladybeetles.

Scarabaeidae—Stout-bodied June beetles, Japanese beetles, et cetera.

Lucanidae—Stag beetles, mandibles often branched, like antlers.

Cerambycidae—Long-horned beetles, cylindrical, with long antennae; larvae are wood borers.

Chrysomelidae—Leaf beetles, small, short-bodied, oval, with short antennae—Colorado potato beetles, flea beetles, et cetera.

Bruchidae—Larvae living in seeds of plants; pea, bean weevils.

Curculionidae—Curculios or snout beetles; head prolonged into a snout; all plant feeders—plum curculio, cotton boll weevil, et cetera.

Scolytidae—Bark and timber beetles.

In considering the different beetles I am following the entirely artificial scheme set up for this book as a whole, *i.e.:* treating them alphabetically under approved common names. If a beetle is commonly known in its larval state as a borer, then it is discussed under Borers; if its approved name is curculio, it is considered under curculios; and if it is commonly called a weevil, it is treated under Weevils. This is chiefly for your convenience in referring back from the plant section to the Bugs. If your pest is called a borer in the Host section (page 419), look it up first under Borers, and not under Beetles. Cross-references will help to keep the relationships straight.

Alder Bark Beetle (*Alniphagus aspericollis*)—A black, destructive miner in living, injured, or dying red and white alders, distributed along the West coast, preferring young trees, but also killing older trees.

Alder Flea Beetle (*Altica bimarginata*)—Widely distributed. This is a dark, shiny, steel-blue beetle only 1/5 inch long, with a longitudinal fold on sides of the elytra. Adult beetles hibernate in protected places, lay orange eggs on alder leaves in late spring. Larvae, dark brown with black heads, feed on both sides of the leaf, eating everything but veins, during July and August. Pupation is in the ground; there is only one generation. This common flea beetle may nearly defoliate alders; feeds also on poplar and willow.

Control. Spray with lead arsenate when larvae are young. A parasitic fungus kills many of the beetles.

Alfalfa Snout Beetle (*Brachyrhinus ligustici*)—A European pest first noted in this country near Oswego, New York, in 1933, feeding on raspberries. Since then it has been found on rhubarb and strawberry as well as its chief host, alfalfa. To date it has been confined to a small section of New York State.

AMBROSIA BEETLES, or **TIMBER BEETLES**—A group of the Scolytidae or bark beetle family. They burrow in solid wood and cultivate fungi, called ambrosia, on which they feed. Commonly destructive only to forest trees; a few species attack living fruit trees, usually those in unhealthy condition. One species, called the pear-blight beetle, causes a twig injury similar to that produced by bacterial fire blight.

Apple Flea Beetle (*Altica foliacea*)—Metallic bright green or dark

blue, found in the Southwest. It normally feeds on evening primrose but may strip grapevines and apple foliage, and sometimes feeds on raspberry, strawberry, radish, and some other plants.

Argus Tortoise Beetle (*Chelymorpha cassidea*)—A tortoise-shaped bright red beetle with black spots, feeding on morning glory, moonflower, sweet potato, cabbage, corn, and raspberry. The larvae are yellow with brown spots. This species is present throughout the East and as far west as New Mexico.

Ash-gray Blister Beetle (*Macrobasis fabricii*)—A common eastern species, destructive to forage and truck crops. It is about ½ inch long, ash-gray in color. It ranges west into Arizona and Idaho where it may be abundant, with the larvae feeding on grasshopper eggs.

Asiatic Beetle—See **Oriental Beetle.**

Asiatic Garden Beetle (*Autoserica castanea*)—First reported in New Jersey in 1922 and since found at scattered points along the Atlantic seaboard from Massachusetts to South Carolina. The area of continuous infestation covers about 4,000 square miles around New York City. Apparently this beetle dies out in regions of low summer rainfall. It resembles the Japanese beetle in shape and size, but is a uniform cinnamon brown, and comes out to feed *only at night.*

Asters are first choice as food plants, but more than 100 different plants are acceptable, including beet, carrot, corn, eggplant, kohl-rabi, parsnip, pepper, and turnip among the vegetables; aster, azalea, chrysanthemum, dahlia, delphinium, rose, zinnia in the ornamentals; and such fruits as cherry, peach, and strawberry.

The life history also resembles that of Japanese beetles, with the winter passed as larvae deep in the soil under grass roots. The grubs come back near the surface to feed on grass roots during April and May, pupate, and emerge as adults during June, July, and August. The beetles lay eggs in the ground near grass roots, and young larvae feed on roots through September and October before going below the frost line for winter.

The adults may be very numerous at night, flying toward lights, banging into screens, flying into automobiles. Damage to plants is most serious on foliage near the ground; leaves have numerous irregular holes eaten in from the margin. Lawns may turn brown in patches.

Control. Grub-proof lawns with lead arsenate as for Japanese beetles, and spray plants with lead arsenate and flour, or with a special rotenone spray.

Asparagus Beetle (*Crioceris asparagi*)—Introduced from Europe about 1856 and now present wherever asparagus is grown. The beetles are slender, ¼ inch long, metallic blue-black with red and yellow markings. (Plate IV, page 111.) Beetles winter in protected places about the garden,

go over to asparagus when shoots come up in the spring, feed on the stems, and lay dark brown eggs attached by one end. The eggs hatch into olive-green, grayish, or black larvae which gnaw stems and leaves for 10 to 12 days, during which period the asparagus may be almost defoliated and the plants stained by a dark fluid secreted by the larvae. They pupate in cells in the soil. The entire life cycle takes about a month; there are at least two generations in the North, three or more in the South and California.

Control. Cut frequently, every 3 to 5 days, before the eggs can hatch; spray or dust with rotenone, changing to calcium arsenate when the cutting season is over. Nicotine dust will kill young larvae, and cultivating the soil will expose pupae. Ladybeetle larvae and predaceous plant bugs help keep the asparagus beetle in bounds; a chalcid wasp is a parasite.

Balsam Bark Beetle (*Pityokteines sparsus*)—One of the smaller bark beetles, occasionally destructive to balsam.

Banded Cucumber Beetle (*Diabrotica balteata*), also called **Belted Diabrotica**—It is light green with 3 bands of darker green, primarily a pest of beans in the Gulf states, and does not seem to be of much importance on cucumbers or other legumes.

BARK BEETLES are particularly injurious to forest trees, but some species may seriously injure ornamental plantings. The beetles are small, usually ¼ inch or less in length, cylindrical, stout, dark brown or black. They all look much alike and are identified chiefly by the type of gallery or mine they make under the bark of the host tree. The adults excavate egg tunnels in the inner bark and sapwood, while the grubs make tunnels branching off from the central chamber. Small holes in the bark indicate exit holes for the beetles.

Some bark beetles breed in healthy trees and some inhabit only weak or dying trees. The most famous bark beetle at the moment is probably the smaller European elm bark beetle, chiefly responsible for disseminating the Dutch elm disease.

Control generally lies in cleaning up all dying wood and burning it before the beetles can spread. Ornamental trees should be kept growing vigorously with proper food and water; severely infested trees should be cut down. Bark beetles have a number of natural enemies.

Bean Leaf Beetle (*Cerotoma trifurcata*), also known as the **Three-spotted Bean Beetle**—It is abundant in the southeastern states, ranges west to Texas and New Mexico, north to Kansas and New York. The beetle is yellow-buff to dull red, ¼ inch long, with 3 or 4 black spots on inner edge of wing covers and a black band near outer margins. (Figure 30.) The adults chew holes in leaves, feeding from the underside, but white larvae feed on roots and nodules, chew the stem under the soil line,

and may girdle it. There are one or two broods a year on beans, corn, cowpeas, peas, soybeans, and various weeds.

Control is the same as for the Mexican bean beetle, which see.

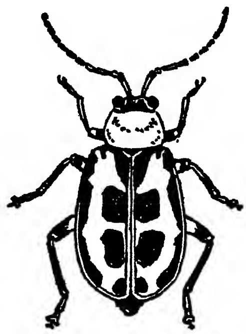


Figure 30

Bean leaf beetle

Beet Leaf Beetle (*Erynephala puncticollis*)—A western species but extending east to the Atlantic states, injuring table and sugar beets and spinach. The beetle is ⅓ inch long, dull yellow with black margins, and black spots on the thorax. The grayish olive-brown larvae are marked with raised tubercles and yellow spots resembling those of lady beetles. Both larvae and adults feed on foliage, with the former most injurious. Destroying weed hosts and cleaning up winter shelters are the only controls suggested.

Black Blister Beetle (*Epicauta pennsylvanica*)—An all-black species common in the East, often feeding ravenously on china asters and Japanese anemones.

Black Elm Snout Beetle (*Magdalis barbita*)—A small, jet-black beetle with a prominent snout, found from New York to South Dakota and south to Georgia. The beetles emerge from branches of unhealthy elms in May or June and lay eggs in bark. The young grubs burrow to the inner bark and sapwood, mining longitudinal galleries 1½ inches long. Maintaining vigor of trees and watering during droughts are best preventions of bark beetle trouble.

Black Turpentine Beetle (*Dendroctonus terebrans*)—An eastern bark beetle working near the base of pine and spruce.

BLISTER BEETLES are rather long and slender, with the prothorax narrower than the soft and flexible wing covers. The name comes from the cantharidin in their bodies, a powerful blistering agent formerly used in much the same fashion as a mustard plaster.

It was a European blister beetle, the "Spanish Fly," that was chiefly used for blistering in the old days, but American blister beetles are used

in modern medicine as an internal stimulant and in animal breeding. A certain drug company offered to buy beetles collected in quantities in gardens not so long ago. Blister beetles have other names: old-fashioned potato bug is one; another, favored in the South, is Yankee bug.

The life history of blister beetles is peculiar, to say the least. (Plate V, page 118.) They differ from most beetles in being predaceous and therefore helpful to us in the larval state, but phytophagus or plant-eating as adults. There are about 250 species in this country (2,000 in the world), black or gray, plain or striped or margined, and found in all parts of the United States. In a typical form the beetle winters as a partly transformed larva, known as a pseudopupa, in an earthen cell in the soil. More than one winter may be spent in this suspended state, but in some spring the pseudopupa molts, acquires functional legs, moves about for a while, then goes into the true pupal stage, which lasts about 2 weeks.

The adults come out in swarms in June or July or later. They feed gregariously on flowers and foliage; the females lay yellow eggs in clusters of about 100 in holes in the soil. In 10 to 21 days active, strong-jawed larvae start burrowing through the soil until they find the egg mass of a grasshopper. They gnaw into the egg pod and eat the eggs. The larvae molt 4 times, going through a series of changes in form, known as hypermetamorphosis. The first larval state is called a triungulin, and the active triungulins seem to specialize in eating eggs of the two-striped and differential grasshoppers.

In a few days the triungulin sheds its skin and assumes a very different larval form, more like the usual grub. There are 4 other molts, 1 to 4 days apart, the last stage feeding for 2 weeks and then burrowing into the soil to build an oval cell in which it molts to form a hard-shelled, immobile object called the coarctate stage, or pseudopupa. Normally there is one generation a year, but the pseudopupa may remain dormant for 2 or 3 years.

Blister beetles are found on many vegetables—bean, beet, cabbage, cowpea, corn, carrot, eggplant, melon, onion, pea, pepper, potato, pumpkin, radish, soybean, spinach, sweet potato, Swiss chard, tomato. They also injure some vines, especially clematis, and are very common in July and August, sometimes September, on aster, Japanese anemone, zinnia, occasionally on chrysanthemum and other flowers.

Blister beetles are hard to control since they are rather resistant to most arsenicals. Fluosilicate sprays, either barium fluosilicate or cryolite, are quite successful; and pyrethrum is good, being even more effective when mixed with rotenone. Bordeaux mixture acts as a repellent. Beetles can be picked or knocked off into a jar of water with a layer of kerosene on top. Don't crush them against the bare skin, for fear of some blistering effect from the cantharidin.

Blueberry Flea Beetle (*Altica torquata*)—Coppery bronze, feeding on blueberry foliage in Maine and also recorded in Connecticut.

Boll Weevil—See under **Weevils.**

Bronze Birch Borer—See under **Borers.**

Bumble Flower Beetle (*Euphoria inda*)—An eastern species, ranging west into New Mexico and resembling a bumblebee. It is ½ inch long, broadly oval, yellowish-brown mottled with black spots. Adults feed on apples, ears of corn, grapes, and peaches; larvae develop in dung and rotting fruit. Clean up such materials around the corn patch.

BURYING OR CARRION BEETLES (family Silphidae) are of no great concern to the gardener since they feed on dead mice, birds, or other carrion or decaying vegetable matter, burying their food by digging under it; but a few species are known to feed on plants. They are robust beetles usually with the wing covers shortened to expose the tip of the abdomen.

Garden Carrion Beetle (*Silpha ramosa*)—Black with a velvety sheen, often present in lawns and sometimes feeding on garden or field crops, although its chief food is decomposed vegetable matter.

Injurious carrion beetles are controlled with poison bran mash, as for grasshoppers.

Spinach Carrion Beetle (*Silpha bituberosa*)—Black with 3 longitudinal ridges on each elytron; lays eggs in soil which produce black and white larvae. The latter feed at night on edges of leaves and may be quite destructive to beets and spinach in May, also to squash, pumpkin, and some other vegetables. This is a plains and mountain species, occurring in Montana, Wyoming, Washington, Kansas, and Nebraska.

Cabbage Curculio—See under **Curculios.**

California Ladybeetle—See under **Ladybeetles.**

California Prionus—See under **Borers.**

Carrot Beetle (*Ligyrus gibbosus*)—Occurring over much of the United States except the most northern states. It attacks carrot, beet, celery, corn, cotton, dahlia, elm, oak, parsnip, potato, sunflower, and weeds, especially amaranthus. The beetle is ½ inch long, broad, reddish-brown with stout legs. It winters as an adult in the soil, even down as far as 4 feet, emerging in spring to lay eggs at night in the soil. The larvae, resembling common white grubs, bluish-white, curved, with brown heads, feed on roots of grasses and sometimes corn and other crops. There is one generation with chief injury from April to August.

No artificial-control measures are advised, except prevention by cleaning up piles of rotting vegetables. Parasites play an important part in reducing the numbers of carrot beetles.

Carrot Weevil—See under **Weevils.**

Checkered Beetles are useful beetles known by their checkered patterns

or markings. One species is known to feed on codling-moth larvae, but most feed on bark and other wood-boring beetles and are very efficient in keeping these forest pests under control.

Cherry Leaf Beetle (*Galerucella cavicollis*)—Present throughout the East in large numbers at intervals of several years. Adults are small red beetles, less than ¼ inch long, feeding on foliage of peach and cherry, sometimes plum, occasionally apple. Brown larvae with yellow and black spots feed only on wild cherry. There is one generation a year.

Spray foliage with lead arsenate, safened for stone fruits.

CLICK BEETLES are very common, elongate, slightly flattened, somewhat pointed beetles with the remarkable ability of righting themselves with a smart "click" and flip into the air when placed on their backs. They may throw themselves several inches up in space, and if they do not come down in the right position they keep on trying until they land on their feet. They belong to a large family, the Elateridae, with more than 500 species, all plant eaters. The chief damage is done by the larvae, very long and narrow, very hard and shiny, called wireworms; these live in the soil and seriously injure roots of corn, wheat, potato tubers, and other vegetables. See Wireworms.

Colorado Pine Beetle (*Dendroctonus approximatus*)—A small, reddish-brown bark beetle attacking injured yellow, Arizona, and Chihuahua pines in the Southwest and preventing recovery.

Colorado Potato Beetle (*Leptinotarsa decemlineata*)—A large leaf beetle, an example of a native insect which suddenly became dangerous to cultivated plants. (Plate IV, page 111.) For many years this beetle lived on the sandburr on high plateaus at the base of the Rocky Mountains. It was described in 1824 and had probably been around as an obscure beetle for a long time. But the pioneer settlers of the West brought with them the potato, which the beetle found much to its taste. In a short time this almost unknown insect became, under the title of "potato bug," the best-known beetle in all America.

It migrated eastward, at the rate of about 85 miles a year, following potato plantings, appearing in Nebraska in 1859, Illinois in 1864, Ohio in 1869, and reaching the Atlantic coast by 1874; eventually it made its way over to Europe, where it is well established in northwestern countries. It appeared in England but was eradicated there. In this country it is now a problem in nearly every state east of the Rockies and is present in Oregon and Washington.

The Colorado potato beetle is just under ½ inch long, very broad, very convex, yellow with 10 longitudinal black lines and with black spots on the thorax. It winters as an adult in the ground, emerging as soon as potatoes are up to lay bright, orange-yellow eggs in small clusters on

undersurface of leaves. These hatch in 4 to 7 days into very humpbacked, fat red grubs, which feed for 2 or 3 weeks, then pupate in the ground. Beetles emerge in another week or two to lay eggs for the second generation, adults appearing early in autumn to feed for a while, then enter the soil for hibernation. In the South there may be three generations.

Both beetles and larvae completely ravage potato foliage, often destroying whole fields. Although potato is the preferred food plant, the beetles sometimes go to other members of the nightshade family, especially eggplant and tomato.

Control. Hand-picking was the first control measure against the Colorado potato beetle. What farm boy of the past generation has not had to pick his quota of potato bugs! Paris green was the first poison tried, followed by London purple, and then by calcium or lead arsenate, with zinc arsenite and cryolite sometimes used. DDT is now very much in the potato picture and may supersede the arsenicals in the near future.

Calcium or lead arsenate may be added to bordeaux mixture used for controlling potato blight, at the rate of 1 rounded tablespoon per gallon; or it may be applied as a dust, using 1 part calcium arsenate to 3 parts hydrated lime. Cryolite can be used with talc or gypsum but not with bordeaux mixture or lime. Two or 3 treatments may be enough. Spray first when the potatoes are only a few inches high, and again a week or two later. *Keep foliage covered during periods of most rapid growth.*

Convergent Ladybeetle—One of our best friends. See under Ladybeetles.

Corn Billbugs (*Calendra* spp.)—Snout beetles present through grasslands and cultivated areas of the United States, but more destructive from the Great Plains eastward. The maize billbug and the curlew-bug of southern states are common species, causing serious losses to corn by tunneling and feeding inside the stalk, and making holes in developing leaves while they are curled in the heart of the plant. The grubs feed on the fibrous roots of small grains and cultivated grasses, on rice and peanuts.

The billbugs vary from 1/5 to 3/4 inch in length, have a cylindrical curved snout (like a curculio), hard body wall and wing covers, and "play 'possum" when disturbed. They are reddish-brown to black, often so covered with mud that the color cannot be told. They gouge out a small hole in the stalk for each white, kidney-shaped egg. The grubs are short, white, chunky, humpbacked, legless, with a hard brown or yellow head. They eat out the pith of the stem and then go down to the roots.

Control. Practice crop rotation so that corn does not follow corn. Fall plowing or spading followed by clean cultivation is helpful.

Corn Flea Beetle (*Chaetocnema pulicaria*)—A small, brassy beetle,

more dangerous for its ability to disseminate bacterial wilt of corn, known as Stewart's disease, than from its feeding, which results in small perforations all over the corn foliage. The beetles not only inoculate the corn with bacteria but winter the disease organisms in their alimentary tracts. See also Flea Beetles.

Corn Sap Beetle (*Carpophilus dimidiatus*)—A very small brown scavenger beetle that also eats corn kernels, getting into the ear when the husk is loosened by birds, or following after corn earworms.

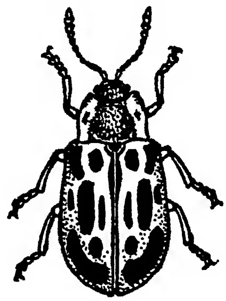


Figure 31

Cottonwood leaf beetle

Cottonwood Leaf Beetle (*Chrysomela scripta*)—Occurring throughout the United States from coast to coast and often more injurious to willows than to cottonwood and other poplars. (Figure 31.) The beetle is about 1/4 inch long, with black head and thorax, the latter bordered with orange-red, and golden wing covers carrying a purplish line at the inner edge and each bearing 7 purple-black spots. The larvae are dirty yellow with brown heads, black legs, and emit drops of pungent milky fluid when disturbed. They skeletonize the leaves and may completely defoliate trees, especially in the West, basket willows being particularly subject to attack. The pupae hang downward from the leaves.

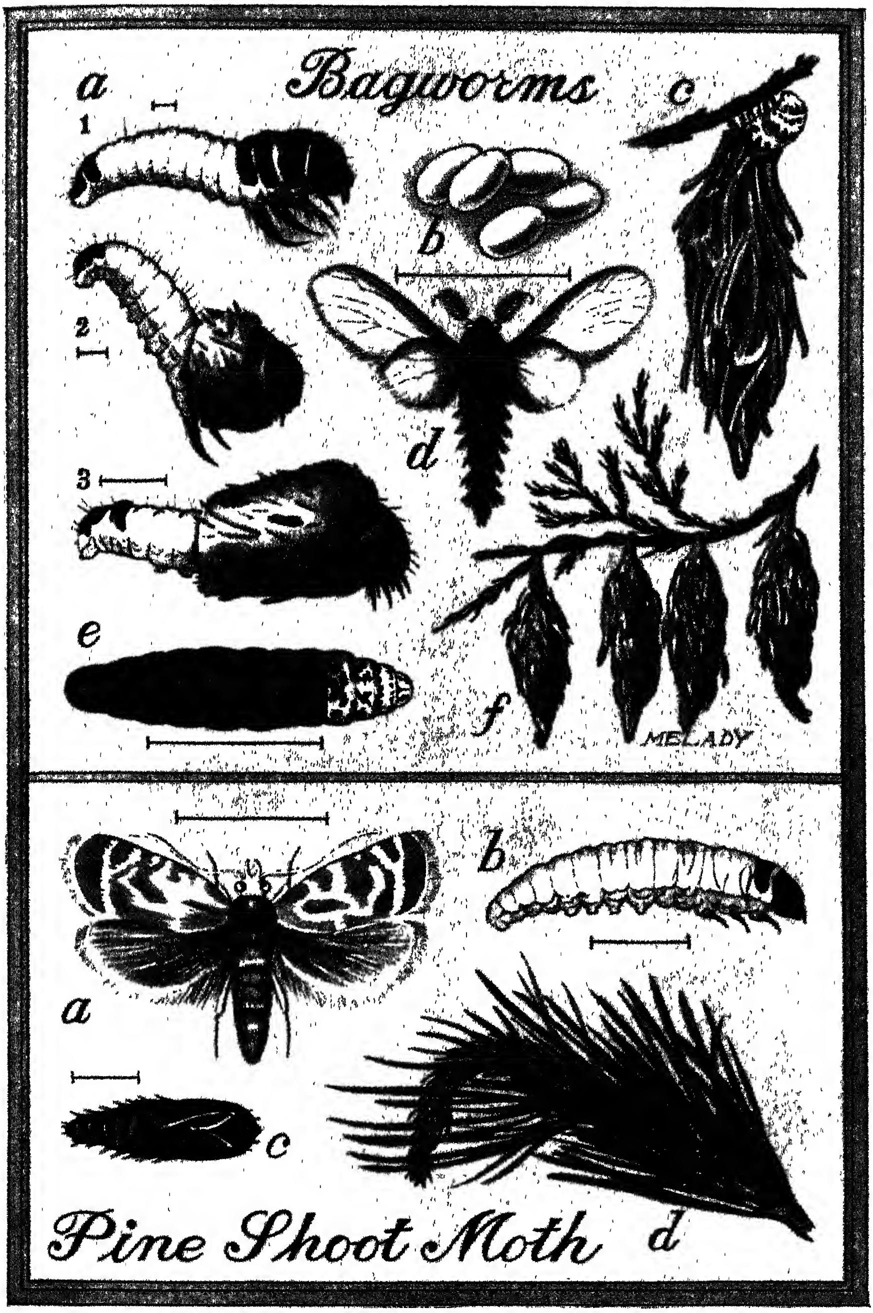
Control with lead arsenate, early in the season when larvae are young.

Cowpea Curculio—See under **Curculios.**

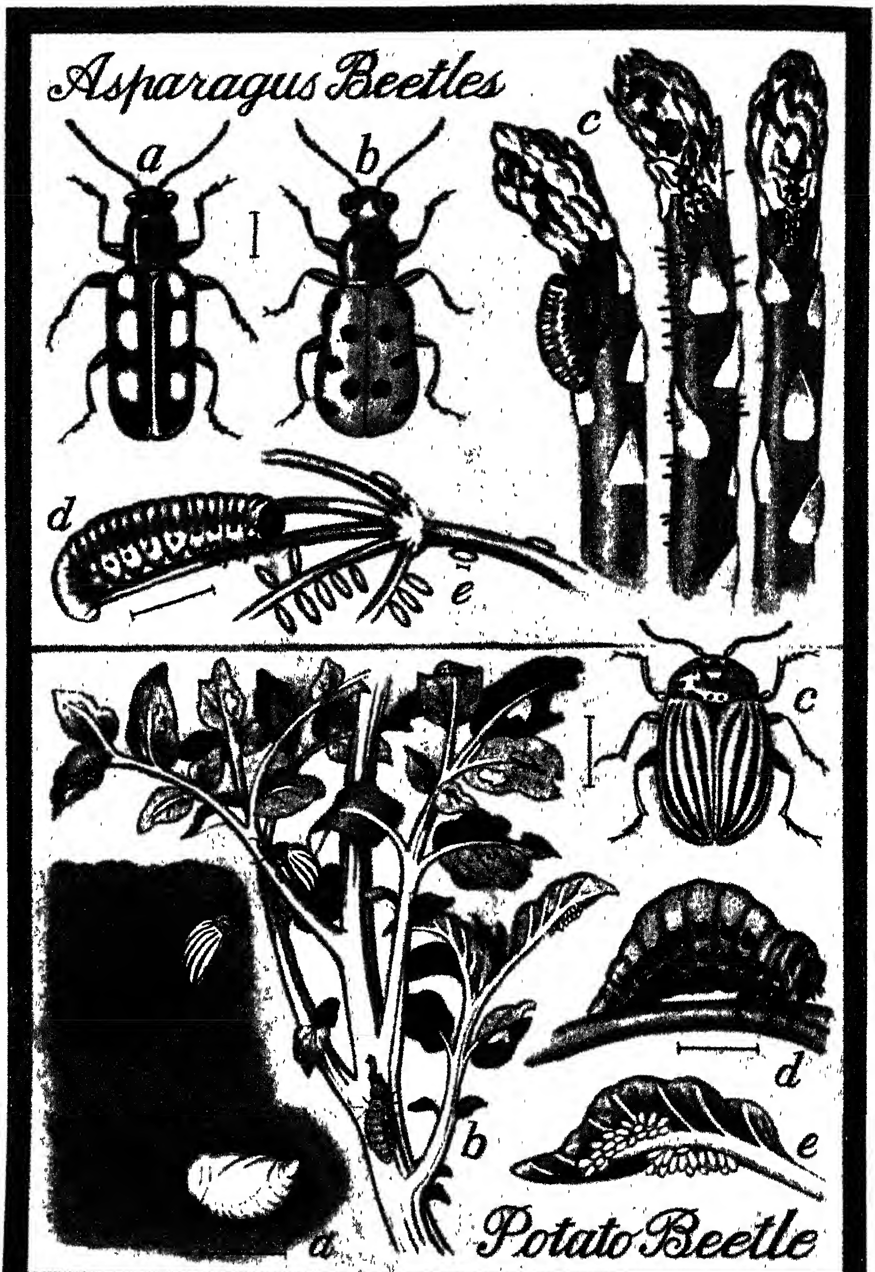
Cowpea Weevil—See under **Weevils.**

CUCUMBER BEETLES—See **Spotted Cucumber Beetle, Striped Cucumber Beetle, Western Spotted Cucumber Beetle, Western Striped Cucumber Beetle.**

DARKLING BEETLES are uniformly black ground beetles, varying in size, primarily inhabiting warm climates and especially abundant in the Southwest, although found almost anywhere. They feed chiefly on dry or decaying vegetable matter, mealworms and flour beetles being typical forms, but some species attack grapes, especially the buds.



III **BAGWORMS:** **(a)** caterpillar (larva) showing first, second, and third stages of bag or cocoon construction; **(b)** eggs (highly magnified); **(c)** female in bag (actual size); **(d)** winged male moth; **(e)** wingless female removed from bag; **(f)** bags in winter. **EUROPEAN PINE SHOOT MOTH:** **(a)** moth; **(b)** caterpillar (larva) removed from infested tip; **(c)** pupa; **(d)** pine shoot with typical crooking and discoloration of tip.



IV **ASPARAGUS BEETLE:** **(a)** adult; **(c)** typical injury to asparagus shoots by grubs and beetles; **(d)** grub (larva) and eggs (enlarged). SPOTTED ASPARAGUS BEETLE: **(b)** adult. **COLORADO POTATO BEETLE:** **(a)** pupa in soil and adult emerging from soil; **(b)** portion of potato vine showing larvae, eggs, and beetles; **(c)** adult beetle (enlarged); **(d)** humpbacked grub (larva) (enlarged); **(e)** egg clusters on underside of potato leaf.

Deodar Weevil—See under **Weevils.**

Desert Corn Flea Beetle (*Chaetocnema ectypa*)—Injures corn, sorghum, small grains in arid Southwest. The beetles feed on foliage, larvae on roots.

DIABROTICA BEETLES. This name is popularly given to the spotted species of cucumber beetles when they infest flowers in the garden. As flower pests they are more injurious in the South and West than in the East. See Spotted Cucumber Beetle and Western Spotted Cucumber Beetle.

DIVING BEETLES (Family Dytiscidae) are predaceous beetles commonly found in ponds and streams, feeding on snails, even small frogs and tadpoles and tiny fish as well as on aquatic insects. The body is streamlined; the legs have hairy fringe to aid in swimming. The adults fly at night and are attracted to lights.

Douglas-fir Beetle (*Dendroctonus pseudostugae*)—A small, reddish- or blackish-brown bark beetle. It usually attacks injured or dying Douglas fir and western larch but is sometimes a pest of living trees. Keep trees growing vigorously; cut down seriously weakened trees.

Douglas-fir Engraver (*Scolytus unispinosus*)—A very small, shiny black beetle making galleries in the bark of normal, injured, or dying Douglas fir, western larch, and Engelmann spruce.

Dried Fruit Beetle (*Carpophilus hemipterus*)—Small, broad, flat beetle, brown with pale spots, wing covers shorter than the body. This is one of the scavenger beetles, a special pest of dried fruit. Clean fruit stored at 40° to 45° F. will remain free from attack.

Eastern Larch Beetle (*Dendroctonus simplex*)—A small, red to brown bark beetle infesting injured, dying, or living larch trees, but more often in forests than isolated specimens on lawns.

Eastern Spruce Beetle (*Dendroctonus piceaperda*)—A bark beetle attacking red, black, and white spruces in northeastern United States.

Eggplant Flea Beetle (*Epitrix fuscula*)—Very small, only 1/16 inch long, black, riddling foliage of eggplant and related plants with minute holes. See Flea-Beetles.

Elm Leaf Beetle (*Galerucella xanthomelaena*)—A very serious elm pest which should be the concern of every citizen, whether or not he be homeowner or gardener. Our fine old elms are a national heritage; they should be protected for future generations. Where town shade-tree commissions are lax or property owners heedless all residents of a community should band together to remedy the situation, to provide funds and education.

The European elm leaf beetle was found near Baltimore, Maryland, in 1838, and apparently arrived in this country a few years previous to that

date. It attacks English, Scotch, Camperdown, and American elms, but does not much bother slippery, rock, and winged elms. It is distributed across the country but is not a pest in parts of the Middle West (where the great elm leaf beetle is on the job). It is definitely injurious in Idaho, Washington, Oregon, and California, and in the latter state has been found feeding on almond and beans. It was recorded as a pest in Utah in 1939.

The beetles are about ¼ inch long, rather slender, yellow to olive-green, with a dark line near the outer edge of each wing cover. (Plate VI, page 119.) As they grow older and get ready to hibernate they darken so that the lines are scarcely visible. Hordes of sluggish beetles are frequently seen crawling into houses in late summer, often through cracks around cellar doors or windows. They are seeking some protected spot for the winter. The elm leaf beetle is usually a pest of towns or cities where buildings offer dry winter hiding places.

The beetles come out from attics or cellars in early spring, mate, and start eating small holes in elm leaves as they begin to unfold. During late May and early June (New Jersey calendar) they lay clusters of lemon-shaped yellow eggs, 5 to 25 in a cluster, on underside of leaves. The egg-laying period may last several weeks, each female laying 500 or more eggs which hatch in 5 to 6 days. The larvae are yellow but so spotted and striped with black that they appear dark. They skeletonize the leaves, eating everything but the veins and the upper cuticle or skin. Maturing in 15 to 20 days, each larva drops or crawls to the ground, transforming into a yellow pupa at the base of the tree. Beetles emerge in 6 to 10 days to feed and lay eggs for the second generation.

The number of generations depends somewhat on the season. There are usually two, but sometimes one and a partial second, or two and a partial third. In the South there are three generations, and in California, where the elm leaf beetle is a most serious pest, there may be four or five generations.

Control. It is not difficult to control the elm leaf beetle if a high-pressure spray apparatus is used and lead arsenate (at 3 to 5 pounds per 100 gallons, with casein or soybean flour as a sticker) is applied when the feeding holes of the overwintering beetles are first seen. A second spraying is due 3 weeks after the first, or when the eggs start hatching.

In many communities 1 spray, rather late in May, will suffice. If the first brood is not controlled, a summer spray should be applied. Usually 2 sprays, properly timed, will take care of cankerworms and Japanese beetles as well as elm beetles.

Unsprayed trees are covered with brown leaves which look like lace or else are completely defoliated by midsummer—a terrible eyesore in towns

priding themselves on their shade trees. Often the elms put out new leaves in late summer, a weakening process. It is said that 3 years' defoliation in succession will kill a tree, and the many dying elms in some towns testify to the truth of this assertion. Weakened trees are hosts to elm bark beetles, which carry the fungus causing Dutch elm disease, so neglect turns into a vicious cycle.

Already in towns around me in New Jersey I can see the effects of wartime neglect of elms. This past summer whole streets of elms were defoliated and were pitifully putting out their next year's leaves in late August and September. Many of our fine elms are dead.

Fortunately the elm leaf beetle has several natural enemies, a most effective one being a white fungus which attacks pupae and adults in late summer. An egg parasite introduced from France in 1908 is established in some areas.

Engelmann Spruce Beetle (*Dendroctonus engelmanni*)—Small, pale brown to dark red or black bark beetle, sometimes killing Engelmann or Canada spruces in the Rocky Mountains and the Northwest.

European Chafer (*Amphimallon majalis*)—A European beetle first noted in western New York in 1940. It causes turf injury similar to that of Japanese beetles or Asiatic garden beetles and has a similar life history. The beetle, a typical scarab, with dark bands at inner edge of wing covers, feeds on leaves of some plants at night, but the damage is negligible. Chief injury is from grubs which, in addition to grasses, work on coreopsis, chrysanthemum, weeds, and roots of evergreen seedlings.

Control measures are the same as for other lawn grubs.

European Ground Beetle (*Calosoma sycophanta*)—Imported from Europe to aid in the control of gypsy and browntail moths. It is brilliant golden-green with a dark blue thorax about an inch long. Adults hibernate in cells in the ground, emerging in late spring to lay eggs in the soil during June and July. The active larvae, hatching in about a week, run over the ground or climb trees in search of caterpillars or pupae. Do not destroy this beautiful friend. See also Ground Beetles.

Eyed Click Beetle (*Alaus oculatus*)—A very large, shiny black beetle with 2 conspicuous eye-like spots on the thorax, sometimes called the owl beetle. The species is carnivorous and is often found in trunks of old apple trees.

Fiery Hunter (*Calosoma calidum*)—A black ground beetle with 3 rows of large copper-colored pits in each wing cover. It is often seen searching for cutworms, potato beetle grubs, and other succulent larvae.

Fig Beetle (*Cotinus texana*)—A large flat, wide beetle, over an inch long, usually green, sometimes coppery to violet. It is a fruit pest in Arizona, New Mexico, and Texas. It prefers ripe peaches but also feeds

freely on apricot, apple, grape, muskmelon, nectarine, pear, tomato, and fruit of cacti. The larvae breed in the dung of old corrals, and the only control seems to be thorough cleaning of corrals and stack bottoms in February, March, and April. There is no effective way of spraying adults feeding on ripe fruit.

FIREFLIES, LIGHTNING BUGS, or **GLOWWORMS,** family Lampyridae, are well known through their luminescence at night. They are a delight to see and equally delightful to gardeners because of their predilection for dining on slugs and snails, sometimes cutworms. In some species the adults, larvae, and eggs are all luminous. The true nocturnal fireflies are found chiefly east of the Rockies; in the West the forms are of the glowworm type, where the female is like a larva and emits light and the male has wings but is not phosphorescent.

Fireflies are soft-bodied beetles of medium size, with light-producing organs on the underside of the abdomen. According to Fabre the contortions of the female body resulting in flashes of light are signals for the male. Other scientists disagree as to the exact function of the light, since it is often present in larvae as well as adults. The light itself is produced by oxidation of a substance called luciferin in a heatless reaction.

Flatheaded Apple Tree Borer—See under **Borers.**

FLEA BEETLES—A very large group of very small leaf beetles named for their habit of jumping like fleas when disturbed. They usually feed on plants early in the season, perforating the foliage with tiny shot holes. The various species go under such names as: corn, eggplant, grape, horse-radish, mint, pale-striped, sinuate-striped, spinach, strawberry, striped cabbage, sweet potato. Many of these are treated separately in this section.

Flea beetles can be controlled with a repellent, like bordeaux mixture, or with lead or calcium arsenate on non-edible plants or vegetables before edible plant parts are formed, sometimes with cryolite or with rotenone, the latter preferred for home vegetables.

Fruit Tree Bark Beetle—See **Shot-hole Borer,** under Borers.

Fuller Rose Beetle (*Pantomorus godmani*)—A grayish-brown weevil 1/3 inch long, with a short, broad snout, eating ragged areas from margins of leaves at night. (Figure 32.) A greenhouse pest in the North, it feeds on many outdoor plants in the South and California, including abutilon, acacia, apple, apricot, azalea, bean, begonia, blackberry, camellia, canna, cape jasmine, carnation, chrysanthemum, cissus, citron, currant, deutzia, dracaena, fuchsia, gardenia, geranium, goldenglow, grapefruit, hibiscus, lemon, lilies, oak, orange, palm, peach, pear, penstemon, persimmon, plum, plumbago, potato vine, prune, primrose, raspberry, rose, scabiosa, strawberry, tangerine, and vinca.

The larvae are white legless grubs living on roots of blackberries, logan-

berries, raspberries, roses, and strawberries chiefly, but also on citrus roots if no other food is available. When larvae are abundant and the roots much injured the foliage turns yellow. The disease called citrus blast is thought to be spread by Fuller rose beetles.

Control. Since the adults cannot fly they can be kept from crawling up trees and shrubs by banding with cotton or tanglefoot. Where this is impractical, spray foliage with arsenate of lead, or dust with cryolite. The beetles are recorded in large numbers in California in the spring and in Virginia in the fall. Along the Gulf coast camellias and other ornamentals are likely to be chewed during the winter. Adjust spraying according to location.

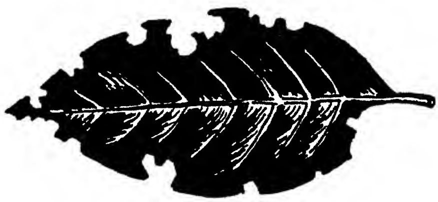


Figure 32

Leaf chewed by Fuller rose beetle

Golden Tortoise Beetle (*Metriona bicolor*)—A small, tortoise-shaped beetle looking like a drop of burnished gold, sometimes called a gold bug. The larvae are dull brown, spiny, and carry their excrement and cast skins in a mass on their backs. They feed chiefly on morning glory, but also on sweet potato and related plants. See also Tortoise Beetles.

Goldsmith Beetle (*Cotalpa lanigera*)—Related to May or June beetles. It is present in the East but more numerous and injurious in the Southwest, especially Arizona, where it defoliates cottonwoods. The beetle is lemon-yellow above, bronze underneath, hairy, about an inch long. The larvae, resembling white grubs, feed at roots of roses, chrysanthemums, cannas, and other ornamentals. The life cycle takes 2 or 3 years.

Grape Bud Beetle (*Glytoscelis squamulata*)—Light gray, ¼ inch long, found on grape buds in California vineyards, usually at dusk in early spring. The larvae feed on grape roots. Canes may be smeared with tanglefoot for control.

Grape Colaspis (*Colaspis brunnea*), the **Clover Root Worm**—Extending from eastern states into Arizona. The adults are very small, pale brown, elliptical beetles covered with rows of punctures. They are general feeders, making long, curved feeding marks, sometimes in a zigzag pattern, on apple, bean, cowpea, clover, dahlia, grape, okra, and rose. In summer eggs are laid at roots of timothy, grape, or clover; the winter is passed in the larval stage, a small, fat, short-legged grub. There is one generation a year. The most severe injury occurs on corn, the feed-

ing of the larvae at the roots causing wilting when plants are 6 to 10 inches high.

Control. Plow or spade in fall rather than spring; do not plant corn after clover; protect flowers by spraying with pyrethrum.

Grape Curculio—See under **Curculios.**

Grape Flea Beetle (*Altica chalybea*)—A small, metallic blue-green beetle feeding on unfolding leaves of grape in spring. Light-brown, black-spotted grubs also eat off buds, chew foliage ragged. The beetle is distributed through the eastern two thirds of the country, feeding also on apple, beech, elm, plum, quince, Virginia creeper. Adult beetles hibernate in or near vineyards; the larvae pupate in soil.

Control. Spray foliage with lead arsenate or bordeaux mixture early in spring. Clean up all debris around the vines. Beetles on back-yard vines can be jarred down onto a piece of cloth and then dropped into oil.

Gray Blister Beetle (*Epicauta cinerea*)—Gray with a yellowish tinge, sometimes present on aster, though a less frequent visitor than the black blister beetle; and on verbena and some other ornamentals.

Great Elm Leaf Beetle (*Monocesta coryli*), also known as **Red Elm Leaf Beetle**—A large yellowish beetle with 9 blue-black patches. Occasionally it appears in large numbers on slippery or red elm, sometimes on American elm, and it is known to feed on hazel and hawthorn. It was first described in 1824, from Illinois, and has since been a pest in Arkansas, Florida, Kansas, Mississippi, Missouri, Maryland, Pennsylvania, Virginia, and West Virginia. It appears suddenly in a locality, does a great deal of damage in a small area, completely defoliating trees for a year or two, and then disappears for an indefinite period.

The yellow to orange larvae feed in groups. They hibernate in the soil, pupate in the spring, with adults appearing late in May. Owing to the sporadic nature of outbreaks, control measures have not been attempted. Presumably spraying with lead arsenate as for the elm leaf beetle would be satisfactory.

Green June Beetle (*Cotinus nitida*)—An eastern species related to the fig beetle (*Cotinus texana*) of the Southwest. It is a fruit beetle, with figs, grapes, and peaches preferred, but feeding also on apple, berries, apricot, nectarine, pear, plum, prune. It is a little smaller than the fig beetle but about the same color, greenish with bronze or yellow margins. It occurs only east of the Mississippi and from Long Island south. The larvae injure grass roots in lawns and golf courses and sometimes corn and other vegetables.

Control. Avoid piles of grass clippings or manure, in which eggs are laid and larvae form, near the lawn or orchard. Try poison bran bait for vegetable seedbeds.

GROUND BEETLES (family Carabidae) feed chiefly on insects but sometimes on earthworms and snails, and occasionally are associated with ants and termites. One or two species may feed on plants, but not very disastrously, and many members of this family are very worth-while additions to the garden. Ground beetles are found most often on the ground lurking under stones, and it ill behooves the gardener to step on them. The beetles do not fly, but run very fast and often climb trees in search of their prey.

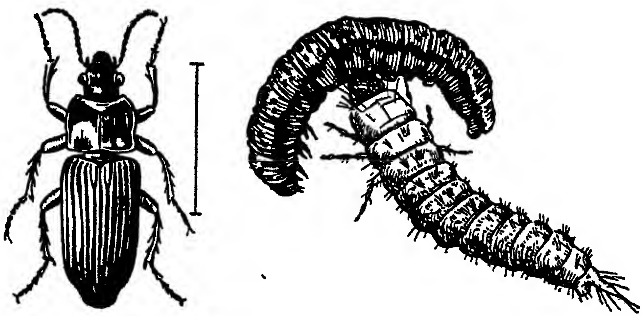


Figure 33

Ground beetle: adult, and larva working on a caterpillar

The shield-shaped elytra seem almost grown together, and are hard and horny with fine longitudinal ridges and rows of punctures. (Figure 33.) The commonest species are black, but some are brown and some a lovely iridescent blue-green. All have ferocious-looking jaws and a very definite indentation between thorax and wing covers. Many secrete an offensive liquid used in defense.

Ground beetles hibernate as adults in the soil, some passing through two winters, although the cycle is usually one year. Eggs are laid in soil. Larvae are flat, heavily chitinized, black and white, with sharp projecting jaws and a pair of bristly appendages at the posterior end of the body. They are more shy and less frequently seen than the adults but are equally predaceous.

Among the more common species are: *Calosoma sycophanta,* introduced from Europe and colonized in New England to control gypsy and brown-tail moths, characterized by green or violet wing covers; *Calosoma scrutator,* called the searcher, the same color as *sycophanta* but larger and with reddish-gold margins on the wing covers; *Calosoma calidum,* known as the fiery hunter, black marked by rows of reddish or copper pits on wing covers, especially valuable in fighting cutworms, armyworms, potato grubs; and the very common all-black beetle, *Calosoma frigidum,* and others.

According to the books most ground beetles feed at night and only the brilliantly colored ones climb trees, but when cankerworms are numerous I frequently find trees, oaks particularly, swarming with black ground beetles in the daytime, lunching on cankerworms. They will even scurry into buildings, especially those with stone floors, in search of their prey.

DON'T STEP ON GROUND BEETLES. THEY ARE YOUR FRIENDS!

Helenium Snout Beetle—This is a very minute black snout beetle which spends practically all season feeding on new tips of helenium. I have not seen it mentioned, yet it seems to be inevitable wherever sneezeweed is grown in any of the gardens I doctor. Weekly spraying with either a stomach poison or a contact insecticide seems to keep it subdued enough to let the helenium come into bloom in autumn.

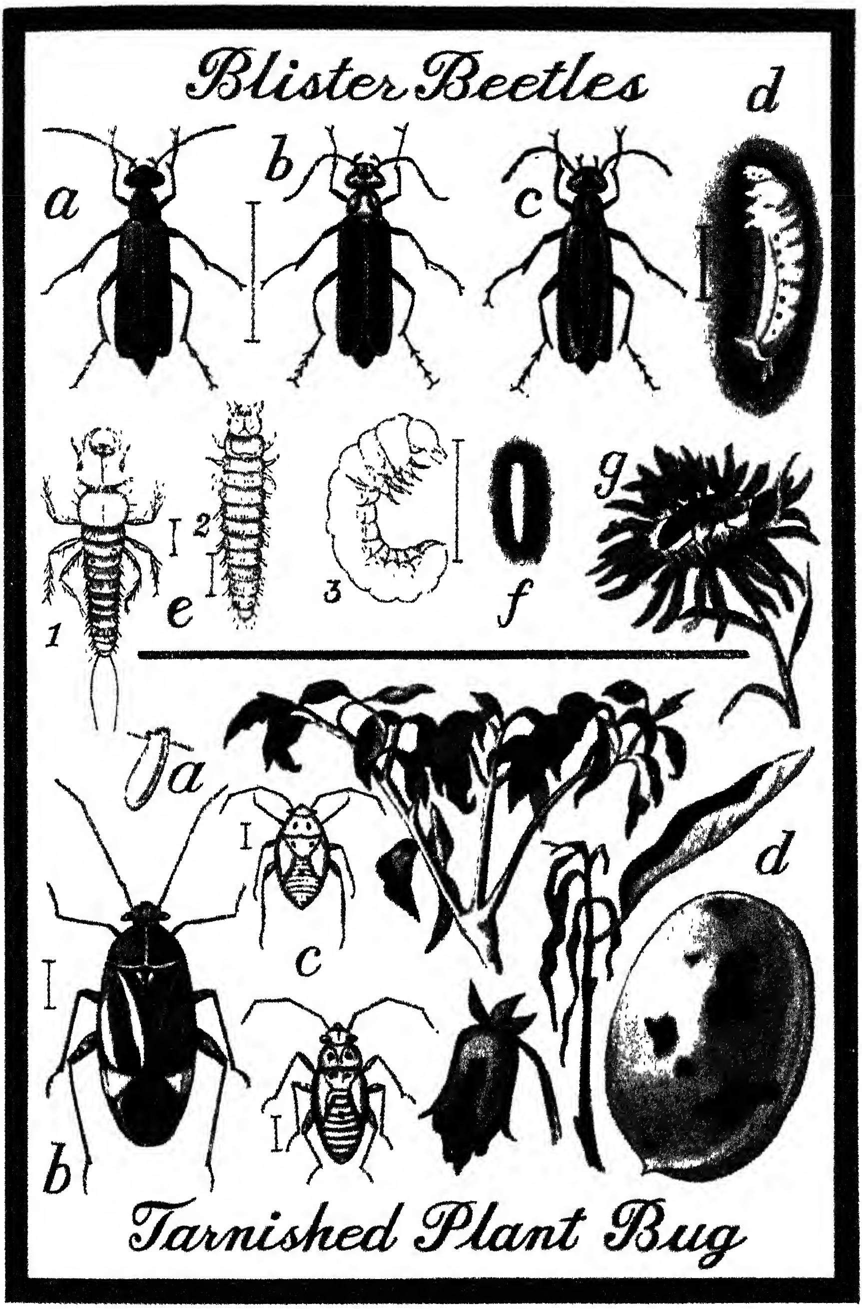
Hemlock Borer—See under **Borers.**

Hickory Bark Beetle (*Scolytus quadrispinosus*)—A bark beetle more important to the homeowner than most members of this group. It is found anywhere east of the Mississippi, and is probably the most destructive enemy of hickory, attacking pignut, butternut, and shellbark hickories and sometimes walnut. The beetle is very tiny, dark brown; even the legless white grub, with brown head, is only ¼ inch long. The grubs mine in the sapwood and inner bark, sometimes girdling trunk and branches. The adults bore into bases of leaf stems, terminal buds, or green nuts. Infested trees lose leaves early in summer, and sometimes tops and branches die back. The bark is covered with small perforations—exit holes of the beetles.

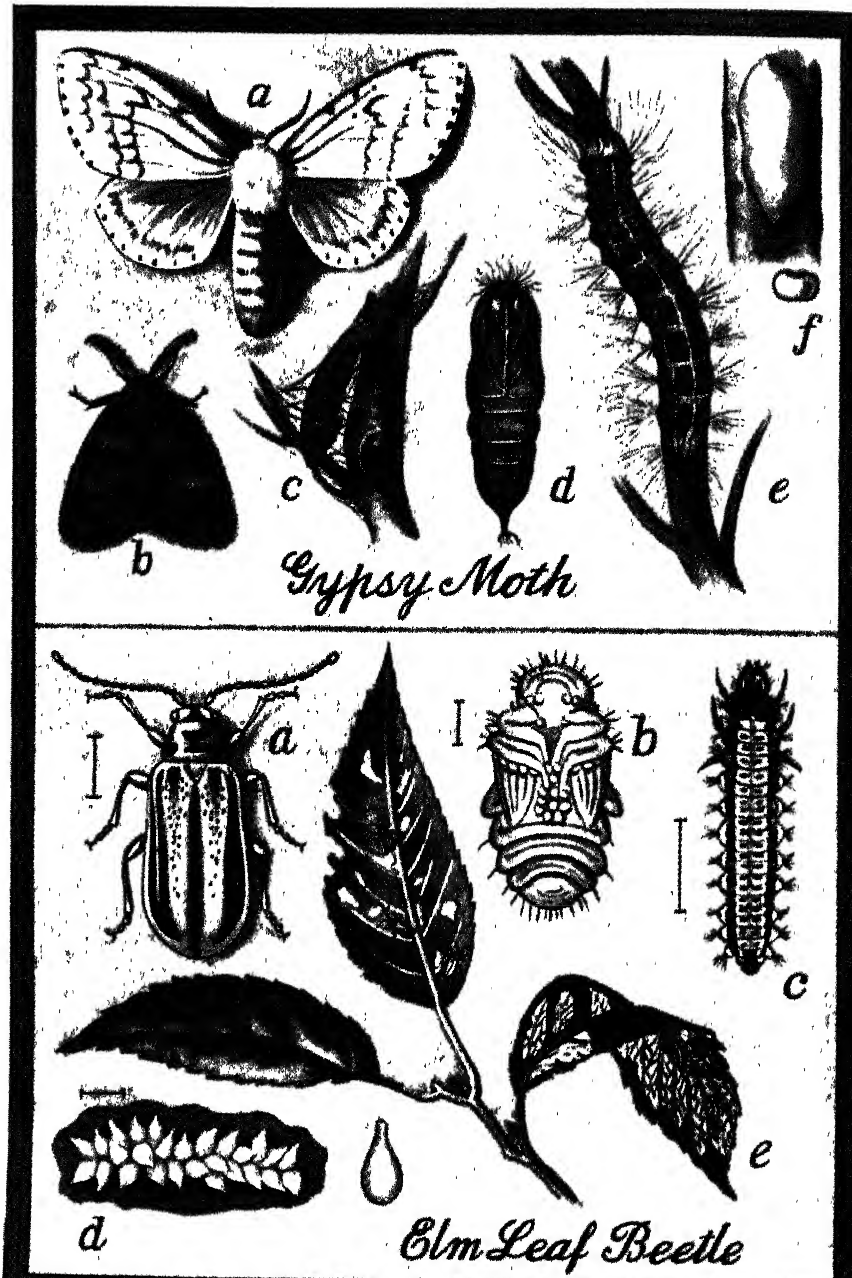
Hibernation is in the bark as full-grown larvae. Pupation takes place in the wood in spring, with the beetles emerging from the end of July into August. (New York calendar.) They fly at once to living hickories, feed for a time on young twigs. The female then bores through the bark to sapwood and makes her longitudinal brood chamber, or egg gallery, with eggs deposited in niches along the sides of the straight tunnel. Grubs, on hatching, burrow out at right angles, thus making a characteristic pattern or engraving in the wood. There is only one generation a year.

Control. Injury is most severe in dry summers, and those trees which are kept well fed and watered are more resistant to such injury. Spraying with lead arsenate while beetles are feeding on buds would offer some slight control. Cutting badly infested trees and burning between October and May, while the larvae are in the burrows, will prevent beetles from going to other hickories. At least 4 hymenopterous parasites work on hickory bark beetles.

Hickory Saperda (*Saperda discoidea*)—Found from New York west



V **BLISTER BEETLES:** **(a)** Gray Blister Beetle; **(b)** Margined Blister Beetle; **(c)** Striped Blister Beetle; **(d)** pseudopupa in soil; **(e)** 1, triungulin or first larval stage, 2, second larval stage, 3, third larval stage; **(f)** egg in soil (enlarged); **(g)** adult feeding on aster. **TARNISHED PLANT BUG:** **(a)** egg, enlarged, inserted in stem; **(b)** adult bug; **(c)** nymph in two instars; **(d)** injury to fruit, bud, terminal shoot, and leaves.



VI **GYPSY MOTH:** **(a)** large female moth; **(b)** small, dark male moth; **(c)** pupa inside scanty thread cocoon; **(d)** pupa (enlarged); **(e)** full-grown hairy caterpillar (larva); **(f)** egg mass. **ELM LEAF BEETLE:** **(a)** adult; **(b)** pupa; **(c)** grub (larva); **(d)** egg cluster on underside of leaf and single egg, much magnified; **(e)** elm leaves skeletonized by larvae and with holes eaten by adults.

to Kansas and south to Louisiana. The female beetle is ¾ inch long with brownish wing covers and curved yellow markings; the male is smaller and dark. Large grubs bore in the sapwood, especially that previously attacked by bark beetles.

Hickory Snout Beetle (*Magdalis olyra*)—An abundant but not such an important insect, mostly confined to diseased and dying trees. It is a black beetle, ⅕ inch long, with a black snout.

Hickory Timber Beetle (*Xyleborus celsus*)—One of the larger ambrosia beetles, which see. It is brown, cylindrical, ⅕ inch long.

Horseradish Flea Beetle (*Phyllotreta armoraciae*)—Small, ⅛ inch long, black with a yellow stripe on wing covers. It deposits eggs in clusters on leaf petioles; larvae burrow into petiole on hatching. Cryolite sprays or dusts are helpful.

Imbricated Snout Beetle (*Epicaerus imbricatus*)—A brownish-gray weevil, about ½ inch long, with 2 pale zigzag lines across the wing covers. This beetle is distributed over most of the United States, extending west to New Mexico and Arizona. It is generally a feeder on apple, blackberry, cabbage, cherry, clover, corn, cucumber, gooseberry, muskmelon, onion, peas, potato, raspberry, squash, sugar beet, watermelon, and weeds. It injures apple by eating out the buds or cutting off young fruit and leaves. Strawberries are often defoliated. Eggs are laid on foliage and larvae live in roots or stems of legumes or other field crops. Adults appear on apples in late May or June, feeding for about a month. There is one generation yearly.

Control measures are not always necessary. Beetles may be jarred from plants onto sheets; or lead arsenate or cryolite sprays used, except on ripening fruits.

Imported Willow Leaf Beetle (*Plagiodera versicolora*)—First recorded in this country in 1919, although it probably arrived a good bit earlier. Its range now extends along the Atlantic seaboard from Connecticut to southern Pennsylvania and as far west as Harrisburg. Poplars as well as several species of willows are attacked. It is rare to find a weeping willow, planted as an ornamental, free from this beetle. (Figure 34.)

The beetle looks like a flea beetle, ⅛ inch long, metallic blue. The larvae are bluish-black, slug-like, with abdomen tapering toward the end. The beetles eat holes through the leaves, but the larvae rapidly skeletonize them, feeding from the underside. Adults hibernate under bark, emerge in late April or May to lay clusters of lemon-yellow eggs on underside of leaves. They hatch in 3 to 5 days, then the larvae feed for about a month before they pupate, attached to the leaf. There are two or three broods during the season, but in my personal experience most damage is done in June.

Control. Spray thoroughly with lead arsenate when the first larvae appear, directing the spray with pressure toward the underside of leaves.

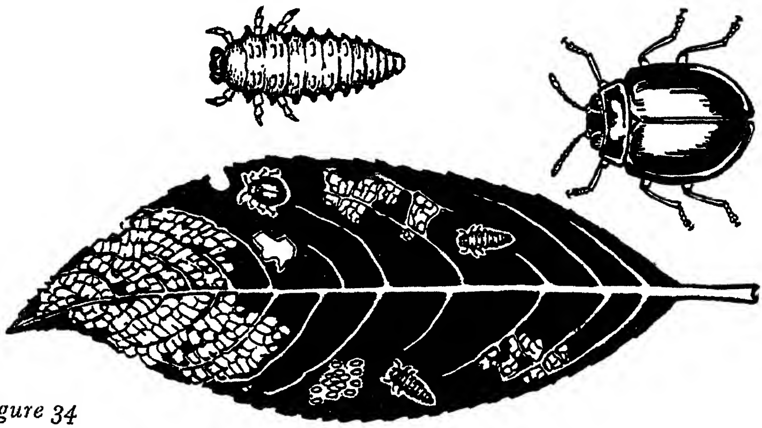


Figure 34

Work of imported willow leaf beetle, with detail of larva and adult

Japanese Beetle (*Popillia japonica*)—A horrible example of an introduced pest which has cost untold millions for lack of a little money and prompt eradication measures when it was first discovered. It probably came here from Japan, as a grub in soil around plant roots, prior to 1912, the year when earth balls and imported plant roots were prohibited. The beetle was noticed in a nursery near Riverton, New Jersey, in 1916. The next year it had covered 3 square miles, with only a half-mile heavily infested. In 1918 the infested area was 48 square miles. It has now covered by natural spread more than 33,000 square miles in eight states, to say nothing of spot infestations where it has hitch-hiked by rail or water, private car or truck, possibly by airplane, although vigorous measures have been taken to prevent this.

According to the Quarantine Revision of February 17, 1945, the area now under Federal Quarantine and considered having continuous infestation includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia. Trapping in other states has located spot infestations in many sections of North Carolina, and occasional beetles have been taken in Florida, Kentucky, Indiana, Michigan, Missouri, and South Carolina. Such scattered outbreaks are controlled by soil treatments or state quarantines.

The area of heaviest infestation, where the Japanese beetle is probably the primary pest of roses, grapes, and many other plants, includes all of Delaware, most of New Jersey, Westchester, Rockland, Richmond, and

into Suffolk counties in New York, eastern Pennsylvania to somewhat west of Harrisburg, and the eastern half of Maryland, including all of Cape Charles and just into Virginia.

Adults feed on about 250 kinds of deciduous fruits, shade trees, shrubs, and garden flowers. Only a few vegetables—asparagus, corn, rhubarb, and soybeans—are among the favored host plants. The beetles are exceedingly fond of ampelopsis (Boston ivy or Virginia creeper), birch, canna, chestnut, elm, hollyhock, horsechestnut, linden, mallow, kerria, marigold, grape, peach, plum, quince, and Japanese quince, raspberry, rose, rose-of-sharon, spirea, turquoise vine, zinnia—to name a mere handful of garden plants on which Japanese beetles can always be expected. In beetle areas it would be wise to substitute English for Boston ivy. Evergreens are seldom bothered by Japanese beetles, and phlox, chrysanthemum, and snapdragon seem not to interest them very much.

A Japanese beetle is a most beautiful insect—until you see it hanging on in clusters of 100 or more over an apple or a single rose. (See Plate VIII, page 135.) It is oval, just under ½ inch long, a gorgeous metallic green with coppery wing covers which are striated or marked with fine longitudinal lines. There are 2 patches of white hairs at the tip of the abdomen and 5 tufts of hairs projecting from under the wing covers on each side. The adult beetle feeds from about the middle of June to late October, with the peak of abundance usually in July (although unfavorable weather early in the season may delay this until August) and a rather sharp falling off in numbers after Labor Day. It likes succulent foliage, chewing young new rose leaves almost to lace, feeds in the hot sunshine and on plant parts that are in the sun, and is attracted to light-colored, showy flowers. It is gregarious, a whole group of beetles demolishing one rose, sometimes in a very short time, before trying the next.

Each female beetle lives from 30 to 45 days, lays 40 to 60 eggs, mostly under grass roots in lawns and golf courses. The grubs hatch in 10 to 12 days, feed on grass roots until cold weather, then move down a few inches (8 to 10) in the soil to avoid freezing. They move upward in spring, feed on grass roots again until pupation in late May. There is just one generation a year. Full-grown grubs are about an inch long, usually found in a curved position, soft but hairy, dirty-white with brown heads.

Control. Both adults and grubs must be fought. First on the list comes hand-picking—removal of beetles from cherished flowers and dropping them into soapy water or a jar of kerosene.

Traps have been of great value in determining newly infested areas. Their value in the home garden is debatable. The most effective traps are painted yellow and are rather an eyesore in the rose garden. They are usually more than odoriferous, for gardeners seldom empty containers

often enough to keep a fragrant garden. The bad smell can now be avoided by using a small salve box covered with DDT in a greasy medium in place of the usual jar. The beetles are attracted to geraniol bait, as in the older traps, fall into the funnel, hit the DDT surface, but then fall free to die. Traps may attract more beetles to a small garden than might normally come, and not all of them are caught. Many feed on foliage and flowers near the trap. If you insist on having traps do not put them near your choicest roses. Your neighbor's lawn is supposed to be the ideal location for a trap!

Lawns may be grub-proofed, spring or fall, with lead arsenate, using about 10 pounds mixed with a bushel of soil or sand and broadcast evenly over 1,000 square feet of turf area. Water well with the hose immediately after application.

Instead of using a poison it is now possible to provide a parasitic disease, called milky disease, for the grubs, by introducing a bacterial spore preparation which is on the market under various trade names. Grubs, inoculated with bacteria in the laboratory, are ground up, mixed with talc to give a standard dust containing 100 million spores per gram. One teaspoon of this dust is applied to lawns at 10-foot intervals.

Federal and state agencies have treated selected areas in Connecticut, Delaware, District of Columbia, Massachusetts, Maryland, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Virginia, and West Virginia with milky-disease spore dust. The general plan has been to treat one block out of ten in city areas, depending on natural spread for the rest. This natural-control method is much slower than applying lead arsenate to the soil, for it takes about 3 years before there is any noticeable reduction in grub population.

In general such treatment is most useful where Japanese beetles have been a problem for less than 10 years, there being usually a 10-year lag between the appearance of the beetle and its natural enemies, bacteria, nematodes, and parasitic wasps.

In regions of serious beetle infestation summer spraying against the adults is almost obligatory. For grapes, peaches, and other fruits where a poison is undesirable, one of the special derris sprays, such as Jap-Ro-Cide or Japellent, is very satisfactory, provided it is applied at least once a week during the peak of the beetle season.

For shrubs and vines a heavy treatment with lead arsenate in late June or early July may last the season, or may need to be supplemented with a second spray in midsummer. For 2 gallons of water use ⅔ cup lead arsenate and 5 tablespoons wheat flour.

Or use 2 cups hydrated lime, 1 tablespoon raw linseed oil to 2 gallons of water, where an arsenical is not wanted.

Pyrethrum sprays give a quick kill of beetles, but do not have much residual effect. Any of the proprietary combination sprays containing lead arsenate or rotenone are satisfactory for keeping beetles off rose leaves and other ornamental foliage (if applied weekly), but to enjoy the flowers they should be cut when buds show color and allowed to open in the house. The main rose season is in June before the beetles are out and in September and October when they are on the wane, so Japanese beetles are really not so much of a threat to roses as commonly thought—certainly they are no reason for giving up roses.

Recent experiments show that DDT is particularly effective against Japanese beetles. Further work is needed before it can be recommended for fruits in the home garden, but it seems to be safe for roses and some ornamentals.

June Beetles (*Phyllaphaga* spp.)—Familiar large, reddish-brown or black beetles, known also as May beetles, June bugs, or daw bugs. They are equally well known as larvae, under the name of white grubs. There are at least 100 species, not to be distinguished by the layman, and all with similar life histories. They are distributed all over the country, probably more serious in the Middle West than in the East.

Adults appear in May, June, or July, flying at night, attracted by lights, trying to enter houses and feeding on foliage of ash, birch, butternut, elm, hickory, Carolina poplar, oak, tuliptree, willow, and perhaps other shade trees. During the day they remain hidden under grass or debris.

The females enter the soil for egg-laying, depositing each egg in a separate ball of earth several inches below the surface of sod land. The eggs hatch in 3 to 4 weeks; the young grubs feed on decaying vegetation and living roots, growing slowly until fall, when they burrow downward. The next spring they move up and seriously injure roots of all kinds of cultivated plants—corn, potatoes, beans, carrots, strawberries, roses, among others. That autumn they again move down in the soil, coming up to feed for a short time in spring prior to forming a pupal cell in the soil. The adults are formed but stay in the cells until the next spring before emerging and feeding as beetles. The usual life cycle thus lasts 3 years, with most damage from the grubs the year after heavy beetle flight. In the South 2 years may complete the cycle, while in most northern states it may take 4 years.

Control. This is not easy. Valuable shade trees can be sprayed with lead arsenate during beetle years, previous records in a locality showing when to expect injury. Turf for lawns and golf courses can be grub-proofed as for Japanese beetles. Avoid larval injury to roots by not planting susceptible crops like corn or strawberries in land recently taken over from sod. Summer plowing will either kill larvae or pupae or expose them to birds.

LADYBEETLES, also called ladybird beetles and ladybugs. They are members of the large family Coccinellidae, a word which means scarlet-red. With the exception of one genus, containing the Mexican bean beetle and the somewhat less infamous squash beetle, all members of this family are beneficial, preying on aphids or scale insects or mealybugs in both their larval and beetle stages.

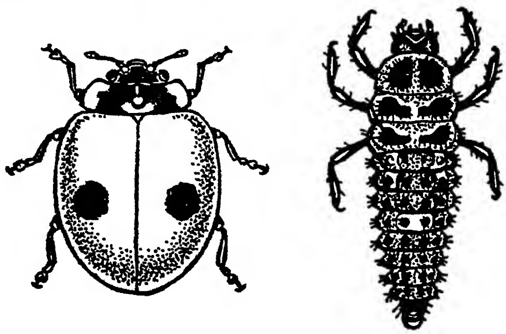


Figure 35

Two-spotted ladybeetle and larva

Ladybeetles are small, from 1/16 to 1/4 inch long, red, or sometimes tan, usually with black spots or black with red spots. They are broadly oval and resemble somewhat destructive leaf beetles but are distinguished by only 3 instead of 4 segments in the tarsus (foot).

Ladybeetle larvae are carrot-shaped with flat bodies broad at the head end, tapering at the other, usually with rather warty backs spotted with blue or orange on a grayish-black background. (Figure 35.) The eggs are usually orange and stand on end in clusters of a dozen or so. The pupae, exposed on the leaf, are cemented to it by one end.

The progeny and potential usefulness of a single female ladybeetle are enormous. Depending on her species, she may lay up to 1,500 eggs over a period of 2 months, though the normal period is about 1 month. The life cycle of each beetle produced from these eggs may be as short as 12 days in warm weather, or take 20 to 35 days in cool weather. As full-grown larvae, ladybeetles consume about 25 aphids a day, and when they change into beetles the daily quota goes up to 50. In a normal season ladybeetles may reduce the aphid population enough so that spraying is unnecessary. But in cool, wet seasons the aphids flourish, the beetles reproduce less rapidly, and the gardener has to get busy to save the crop.

The aphid-eating species of ladybeetles require a lot of plant lice around to maintain themselves. When aphids are reduced to too low numbers most of the ladybeetles starve to death and hence practically disappear until a large aphid colony is built up again. Some of the scale and mealy-

bug species of ladybeetles can, however, survive even when they have reduced harmful insects to a minimum. The proud record of the Australian ladybeetle, introduced to save the citrus industry in California, is described in detail later on under Vedalia, its common name.

Ash-gray Ladybeetle (*Olla abdominalis*)—Pale yellow with numerous black spots; larvae black with orange markings. It is especially fond of the walnut aphid but is a good worker on citrus trees.

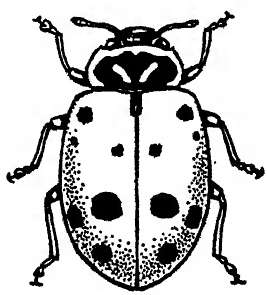
Blood-red Ladybeetle (*Cycloneda sanguinea*)—The most important species feeding on the spirea or green citrus aphid in Florida; pale to blood-red; no marks on elytra.

California Ladybeetle (*Coccinella californica*)—Common species in California, Oregon, and Washington; no marks on red or yellow wing covers; adults often assemble in high mountains like the convergent ladybeetle; feeds extensively on aphids.

Chinese Ladybeetle (*Leis conformis*)—Introduced by the California Citrus Experiment Station from China, and now well established in Florida where each beetle consumes about 200 aphids daily.

Convergent Ladybeetle (*Hippodamia convergens*)—One of our most common and valuable friends, working hard to control aphids throughout North America. (Figure 36.) The adult is black-bodied but with orange or red wing covers, bearing 12 small black spots, and with 2 convergent

Figure 36



Convergent ladybeetle

white lines on the thorax; small, oval in shape. Each female lays from 200 to 300 eggs in clusters on leaves and trunks of plants. These hatch into slug-like, dragon-shaped larvae, gray to black with orange spots. In some parts of the West adults assemble in vast numbers in creeks of mountain areas, hibernating under fallen leaves. Collecting expeditions were formerly organized by the California State Horticultural Commission to go into the mountains and collect the beetles—tons of them—to keep in cold storage until required by growers to control melon aphids and other pests. Adults and larvae feed extensively on aphids and on eggs or grubs of the Colorado potato beetle.

Mealybug Destroyer (*Cryptolaemus montrouzieri*)—Shiny black with head, tips of elytra, and abdomen reddish. It scatters its eggs among mealybugs, and the yellow larvae, covered with waxy filaments, might be mistaken for them. It was introduced from Australia in 1892 and when firmly established is most efficient. Since it eats itself out of business, artificial colonies are maintained to be liberated as needed.

Red Spider Destroyers (*Stethorus* spp.)—Minute black species with the surface finely punctured and covered with very fine hairs; eggs are yellow, pinkish, or gray; larvae are dark with short spines. Larvae and adults prey on various species of red spiders.

Spotted Ladybeetle (*Megilla fuscilabris*)—One of the most common species, varying from yellow to red above, black underneath, with black spots; preys on aphids.

Two-spotted Ladybeetle (*Adalia bipunctata*)—Elytra red with 2 round black spots; thorax margined with white. This is a very common species, and is the form that always comes into my house to spend the winter, where it receives a warm welcome.

There are many more ladybeetles with spots—five-spotted, nine-spotted, thirteen-spotted, fifteen-spotted—and some without spots, but there is not space to list all these friends.

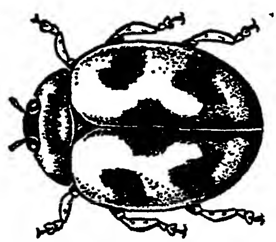


Figure 37

Vedalia, or Australian ladybeetle

Vedalia (*Rodolia cardinalis*)—The Australian ladybeetle, classic example of biological control. This small ladybeetle was introduced from Australia to California to control the cottony-cushion scale, and it has done a bang-up job. It was the first successful use of an imported predator to control an injurious insect pest. The cottony-cushion scale, treated more fully under Scales, is a native of Australia which arrived in California about 1868 or 1869 on acacia. By the early eighties it had overrun citrus orchards, killing hundreds of thousands of orange trees, threatening the whole orange industry.

Sprays were not too successful in checking the scale, so the United States Government and the state of California sent a man, Albert Koebele, to Australia to look up some native parasites. He shipped several

back here, among them *Vedalia cardinalis,* as it was then named. The beetles, only 140 of them, were turned loose to feed on the scale on screened orange trees, and within a year and a half their progeny had brought the scale under control all over the state of California. Since that time Vedalia has been shipped to and established in 32 countries, where she has never yet failed in her fight against cottony-cushion scale.

Normally predators die out when they have reduced their host insects to a low number. Vedalia can live only on cottony-cushion scale, and certainly she has reduced this to low numbers, but she manages to survive somehow, and whenever scale reappears in an orchard along comes Vedalia from some hiding place and checks any chance of a real outbreak.

Vedalia is a small ladybeetle, only 1/8 inch long, red with black markings in a rather mottled pattern. (See Figure 37.) She lays her orange eggs, singly or in groups of 3, under the scale, or thrust directly into the cottony egg mass, and she keeps on laying eggs up to a total of 800 or more. The larvae, dark orange-red, looking something like the scales

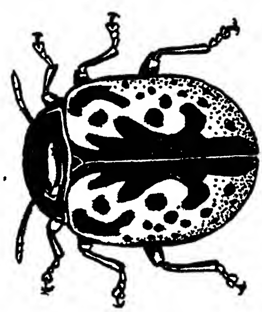


Figure 38

Linden leaf beetle

themselves, feed first on the egg mass and later on all stages of the scale insect. When the Vedalia larva is ready to pupate it attaches the hind end of its body to bark or leaf and hangs downward while the beetle is formed in the pupal skin. An average life cycle is about 35 days.

Lesser Peach Borer—See under **Borers.**

Linden Borer—See under **Borers.**

Linden Leaf Beetle (*Calligrapha scalaris*)—A beautifully colored beetle that feeds on alder, elm, and willow besides linden. (Figure 38.) It is oval, convex, 3/8 inch long, with head and thorax dark coppery-green, wing covers yellowish with a pattern of 2 green branched stripes down the inside, and 11 green dots. The larvae are dirty-white with yellow heads, humped like the potato beetle. Both larvae and beetles feed on foliage and may be controlled by spraying trees with lead arsenate in midsummer.

Live-oak Root Borer—See under **Borers.**

Locust Leaf Beetle—See **Locust Leaf Miner.**

Long-horned Beetles—Wood borers with long antennae. See under **Borers.**

Maple Callus Borer—See under **Borers.**

Margined Blister Beetle (*Epicauta marginata*)—Black, with a narrow gray or yellow margin around wing covers. See Blister Beetles.

Mexican Bean Beetle (*Epilachna varivestis*)—Probably the number-one enemy in eastern home vegetable gardens. (Plate IX, page 142.) Like the Colorado potato beetle it is another example of a pest native to this continent suddenly becoming of great economic importance. For three quarters of a century this beetle was confined to the Southwest, from Colorado south; then, in 1918, it reached Alabama, probably in a shipment of hay. Since 1918 it has increased rapidly and has spread all over the East.

The Mexican bean beetle has the typical convex shape of other lady-beetles, but is larger, 1/3 inch long, coppery-yellow, with 16 black dots, 8 on each wing cover. It infests all kinds of garden beans and cowpeas, is especially fond of lima beans, and does not care much about soybeans, although it will eat them.

The winter is passed as an adult in rubbish or weeds around the garden. When the earliest beans come up from seed a few bean beetles come around; the others straggle in for some weeks. After feeding for a week or two the females lay groups of orange-yellow eggs on the under-side of leaves. These hatch in 5 to 14 days, and the larvae, yellow, soft, but with their backs protected by black-tipped spines, skeletonize the leaves, always working from underneath and eating out very regular areas in a lace-like pattern.

When full-grown the larvae cement their hind ends to an uninjured leaf and the pupae push out of crushed larval skins. The beetles emerge in about 10 days. A complete generation takes about a month. Near New York City there are usually two generations; farther north one and a partial second; farther south three or even four.

Control. The easiest way to control Mexican bean beetles is to dust the vines with rotenone, blowing it up from underneath. Spraying is more trouble and more apt to injure bean foliage. Sometimes magnesium arsenate is used before edible plant parts are formed, but lead arsenate should never be used on beans; it burns the foliage severely. In many sections of the country cryolite, usually as a dust mixed with talc, gypsum, or sulfur, gives excellent control of bean beetles; but in some climates, New Jersey in particular, cryolite may be somewhat injurious to beans. DDT does not control.

Natural parasites are not very effective against this pest, but timing of

planting is a good control method. Near New York City snap beans can be planted in early June and will mature between beetle broods in July. If beetles are particularly numerous in one locality several plantings of bush beans are better than one planting of the long-season pole beans. The second brood of beetles seems more injurious than the first, with pods as well as foliage eaten, so keep up dust treatments. Grow beans for canning early in the season. Clean up and burn all plant debris after harvest, to discourage hibernating adults.

Mountain Pine Beetle (*Dendroctonus monticolae*)—Pale brown to black bark beetle, 1/5 inch long. It infests living and recently felled trees of white, yellow, lodgepole, and sugar pine, preferring young trees or tops of old trees. It is most destructive as a forest pest, killing up to 95 per cent of trees in certain regions.

Native Elm Bark Beetle (*Hylurgopinus rufipes*)—Present over most of eastern and middle western United States. (Plate X, page 142.) It is particularly important because, along with the smaller European elm bark beetle, it may spread the Dutch elm disease. It is a small brownish-black beetle, 1/10 inch long, and not so shiny as its European cousin. It works under elm bark, making a brood gallery transversely across the wood, with larval tunnels coming out at right angles. In Connecticut there are one and a half generations a year, overwintering larvae giving rise to beetles whose progeny hibernate the following winter as adults.

Eggs are laid in dead or weakened trees, the beetles preferring shaded limbs more than 2 inches in diameter, or in cut elm logs. This beetle may also infest basswood.

The only control is removal *and burning* of dying limbs and logs before beetles emerge in spring. There are several natural parasites.

Northeastern Sawyer (*Monochamus notatus*), also called **Pine Sawyer**—Common in northeastern states, attacking white spruce and white, jack, Norway, and western yellow pine. The larvae usually burrow extensively in dead or dying trees but may injure apparently healthy trees. The beetle is large, 1/2 to 1 1/2 inches, with antennae the length of the body in the females and twice that length in males. There is a spiny projection from each side of the thorax.

Prevent trouble by keeping trees healthy.

Northern Brenthian (*Eupsalis minuta*)—A slender beetle with a very long snout. The female bores a hole in the bark with her snout and pushes an egg to the bottom of the tunnel. The long, very slender larvae bore in solid wood of elm, beech, chestnut, oak, and perhaps other trees.

Nuttall Blister Beetle (*Lytta nuttallii*)—A large (inch or more long), metallic green or purplish western species, prevalent in the Rocky Mountain region. It feeds on legumes and on grasshopper eggs.

Oak Twig Girdler (*Agrilus arcuatus*)—A small, slender beetle rather widely distributed. The adult has bronze head and thorax, greenish-brown elytra; the larva is slender, white, ½ inch long. Beetles appear in early July, feed and lay flat green eggs on twigs near terminal bud. Larvae burrow beneath the bark, girdle the twig, and work down the branch. The leaves wilt, the twig dies back. Pupae are formed in the burrows the next year, there being a 2-year cycle. In California a related species (*Agrilus angelicus*) is quite destructive to ornamental oaks, including live oaks. It also has a 2-year cycle, the beetles flying from May to July.

Cutting and burning infested twigs will give some control.

Olive Bark Beetle (*Luperisnus californicus*)—A small black beetle with whitish scales forming a pattern, covered with hairs, and with reddish legs. It works in weakened trees, both olive and ash, but also attacks sound wood. Prune out and burn all infested limbs.

Orange Sawyer (*Anoplium inerme*)—A dark brown, hairy beetle, upward of ½ inch long, recorded from Pennsylvania, Florida, and Texas on orange (the Pennsylvania collection must have been from an indoor plant). The larva feeds on deadwood from old pruning stubs but may go on to healthy tissue.

Oriental Beetle (*Anomala orientalis*)—More often known as the Asiatic beetle and closely resembling in size, shape, and habits Japanese and Asiatic garden beetles. It was first discovered at New Haven, Connecticut, in 1920 and is now found in various parts of that state and in New York and New Jersey. It was previously known in Japan and Hawaii. It is straw-colored with varying dark markings, feeds on blossoms to some extent in the daytime, and is sometimes found on roses along with Japanese beetles. The larvae resemble white grubs, eat roots of lawn grasses. Lawns, if necessary, can be grub-proofed with lead arsenate. See **Japanese Beetle.**

Pacific Flatheaded Borer—See under **Borers.**

Painted Hickory Borer—See under **Borers.**

Pale-striped Flea Beetle (*Systena blanda*)—Probably a native species, most injurious all over the country. The beetle is only ⅙ inch long, pale yellow or brown with a wide, pale stripe down each wing cover. As an adult it perforates leaves of many different plants: alfalfa, bean, beet, carrot, clovers, corn, cotton, eggplant, grasses, lettuce, melon, parsnip, pea, peanut, pear, radish, sunflower, strawberry, tomato, turnip, and many weeds. The larvae are small, slender, white, and feed on many plant roots or in corn seed, causing failure to sprout or a sickly plant. Injury is most serious when cool weather retards seed germination. Pupation is in soil. There is ordinarily one generation a year in temperate climates, two in California.

Control by keeping down weeds, early and late plowing or spading of corn land to starve out the larvae. For control of adults see Flea Beetles.

Pales Weevil—See under **Weevils.**

Pea Weevil—See under **Weevils.**

Peach Bark Beetle (*Phthorophloeus liminaris*)—A native pest abundant in eastern states (south to North Carolina and west to Michigan), attacking mainly peach, sometimes cherry and other stone fruits. This is a small brownish beetle similar to the shot-hole borer, 1/10 inch long. It winters as an adult in pupal cells in dead or dying wood or in special cells cut in the bark of a healthy tree. The egg gallery runs across the wood rather than lengthwise, as with most bark beetles.

Since the beetles are attracted to unhealthy trees, specimens should be kept vigorous by proper cultural methods. *Destroy peach prunings and dying trees.*

Pecan Weevil—See under **Weevils.**

Pepper Weevil—See under **Weevils.**

Pine Bark Beetle, or **Engraver,** (*Ips pini*)—Common throughout the northern United States from Massachusetts to Oregon, attacking all kinds of pines, black and Norway spruce. (Plate X, page 142.) It frequently infests small white pines which have been transplanted; its presence is shown by small circular holes in bark on branches or trunks. The beetle is light to dark brown, 1/8 inch long, burrowing in sapwood on underside of bark. Five or 6 long galleries radiate from a circular brood chamber. There are two generations in New York.

A closely related bark beetle (*Ips calligraphus*) goes under the name of coarse-writing bark beetle. It is also brown but about twice as large.

Prevent trouble by keeping ornamental pines well watered in periods of drought, paying special attention to those recently transplanted. Cut out infested branches and if necessary cut and burn entire trees.

Pine Colaspis (*Colaspis pini*)—Feeds on conifers, pines, and sometimes *Cedrus deodara;* may be numerous in the South. It is a small beetle, 1/8 to 1/16 inch long, gregarious, feeding on green needles, often leaving them hanging by one edge with the tips turning brown. Young trees may die. This is a forest pest but more important on ornamentals. Spray or dust small trees with cryolite or lead or calcium arsenate.

Plum Curculio—See under **Curculios.**

Plum Gouger (*Anthonomus scutellaris*)—A reddish-brown snout beetle, living on wild plum and occasionally going over to domestic plums, prunes, apricots, sometimes peaches and cherries. It resembles the plum curculio but lacks the characteristic humps. The beetle emerges from hibernation early; the larvae pupate in seed of fruit attacked.

Spray before trees blossom and then follow plum curculio schedule.

Poplar Borer—See under **Borers.**

Potato Flea Beetle (*Epitrix cucumeris*)—A common and very destructive small, black, jumping flea beetle. (Plate VII, page 134.) It feeds on potato and related solanaceous plants such as eggplant, groundcherry, pepper, petunia, tomato, and also on apple, arbutus, ash, bean, beet, cabbage, carrot, celery, clover, corn, cucumber, dogbane, elder, holly, honeysuckle, horsechestnut, lettuce, maple, muskmelon, phlox, potato, sweet potato, evening primrose, pumpkin, radish, raspberry, rhubarb, spinach, sumac, sunflower, viburnum, violet, and watermelon. It is present throughout the country.

This flea beetle winters as an adult and in spring goes first to weeds, plantain, and others, or sometimes to tree leaves, but as soon as potatoes or tomatoes appear in the garden the little beetles descend on the young plants in hordes, completely riddling the foliage. They lay eggs in the soil; the larvae feed on tubers and roots and may also be quite destructive, causing scurfy or pimply potatoes. There are usually two broods. In addition to its direct injury the potato flea beetle spreads blight and leaf spot.

There is a Western potato flea beetle (*Epitrix subcrinita*), shiny bronze in color and attacking a similar list of plants.

Control. Tomato seedlings can be dipped in calcium arsenate—spray or dust mixture—before setting, but the easiest control in the back-yard garden is to keep seedlings and young transplants dusted with rotenone. Bordeaux mixture, as used for blight, combined with lead or calcium arsenate, is satisfactory for potatoes. Cryolite is successful in many sections.

Potato Stalk Borer—See under **Borers.**

Quince Curculio—See under **Curculios.**

Raspberry Cane Borer—See under **Borers.**

Red Cedar Bark Beetle (*Phloeosinus dentatus*)—Infests cedars rather frequently, killing weakened trees. The beetle is light brown to black, 1/16 inch long, and its galleries resemble engravings. Keep newly transplanted trees well watered to prevent attack.

Red Elm Bark Beetle (*Magdalis armicollis*)—A reddish snout beetle infesting weakened elms. Keep trees fed and watered; remove dying or injured limbs.

Red Turpentine Beetle (*Dendroctonus valens*)—Found in pine forests throughout the country but injuring ornamental pines in Atlantic states and Monterey pines near San Francisco and Monterey bays. It is a large bark beetle, normally pale to dark red, but sometimes nearly black. It may attack healthy trees around the base, but they either recover or succumb after prolonged infestation. It kills weakened specimens of all kinds of pines and Engelmann spruce.

Red Turnip Beetle (*Entomoscelis adonidis*)—A bright red beetle with black patches on the head and 3 black lines on elytra, ¼ inch long. Bright red eggs, orange to black larvae, and bright orange pupae complete the colorful cycle. The beetles feed at night on cabbage, radish, turnip, wall-flower in northern states.

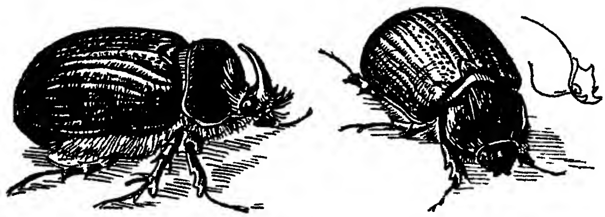


Figure 39

Rhinoceros beetles, the male having a horn, natural size

RHINOCEROS BEETLES of the Scarab family are commonly thought of as large southern species, the larvae living in rotting wood, the beetles having a large horn on top of the head and one or more on the thorax. (Plate XI, page 143.) There is, however, one species known as the **rhinoceros beetle** (*Xyloryctes satyrus*) which is common in gardens along the Connecticut shore and on Long Island. (Figure 39.) The male is black, very broad, well over an inch long, and has a horn curving backward from its head. The female is similar but lacks the horn. The larvae, looking like large June beetle grubs, attack lilacs and sometimes other shrubs or vines just under the surface of the ground, girdling and often killing them. The beetles swarm at dusk. The life history and control measures are not yet very clear.

Rhubarb Curculio—See under **Curculios.**

Rose Chafer (*Macrodactylus subspinosus*)—Familiar to almost everyone as the "Rose Bug" even though it is a beetle, perhaps because its wing covers are not so hard and horny as most. The adult is yellowish-tan, rather slender, with prominent long, spiny legs. (Plate XI, page 143.) It is generally distributed throughout the eastern states and goes as far west as Colorado and Texas, feeding on a long list of plants: apple, bean, beet, blackberry, cabbage, corn, cherry, elder, elm, hollyhock, hydrangea, grape, peach, pear, peony, pepper, poppy, raspberry, strawberry, Virginia creeper, small grains, and grasses.

The rose chafer is more troublesome in sandy areas. It occurs as far south as North Carolina but seems to increase in importance as one goes north from New York City. At least that is my personal observation, but perhaps this is only because Japanese beetles have overrun the Middle Atlantic states and where they move in the rose chafer seems to get crowded out to some extent.

The beetles appear in late May or early June, feed first on blossoms, especially rosebuds and open flowers, and on peonies, then go to newly set fruit and foliage. They ruin rose bloom and young grape clusters about equally. After feeding for 2 or more weeks on roses and grapes they migrate to other plants; then, in early June, burrow into sandy soil to lay eggs, each one in a tiny pocket and a dozen eggs deposited in each of 3 egg-laying periods. The eggs hatch in 2 to 3 weeks, and the grubs, resembling white grubs, but thinner and smaller, eat grass roots. They burrow downward for the winter, come up near the surface in spring, complete their growth, pupate in May, still in the soil.

Control. Usual recommendations call for a lead-arsenate-and-molasses combination, varying anywhere from 2 to 6 tablespoons of the arsenate and from 1/3 to 2 cups of molasses per gallon of water. Such a spray is safe on fruits only early in the season, and for only 1 or 2 treatments.

Spraying roses and other light-colored flowers with Triogen gives temporary control in less sticky fashion, and most of the combination sprays sold under proprietary names for use on roses will protect the flowers for a short period and kill such chafers as are hit with the spray. Hand-picking is always good. Two rose-loving families in Rochester, New York, protect their blooms with a cheesecloth or muslin fence around the beds, stretching slightly higher than the bushes, but with the beds open to the sky. No one seems to know why the beetles do not fly over the barrier and then down onto the roses. As soon as the rose-bug season is over the cloth is rolled up and stored for another year.

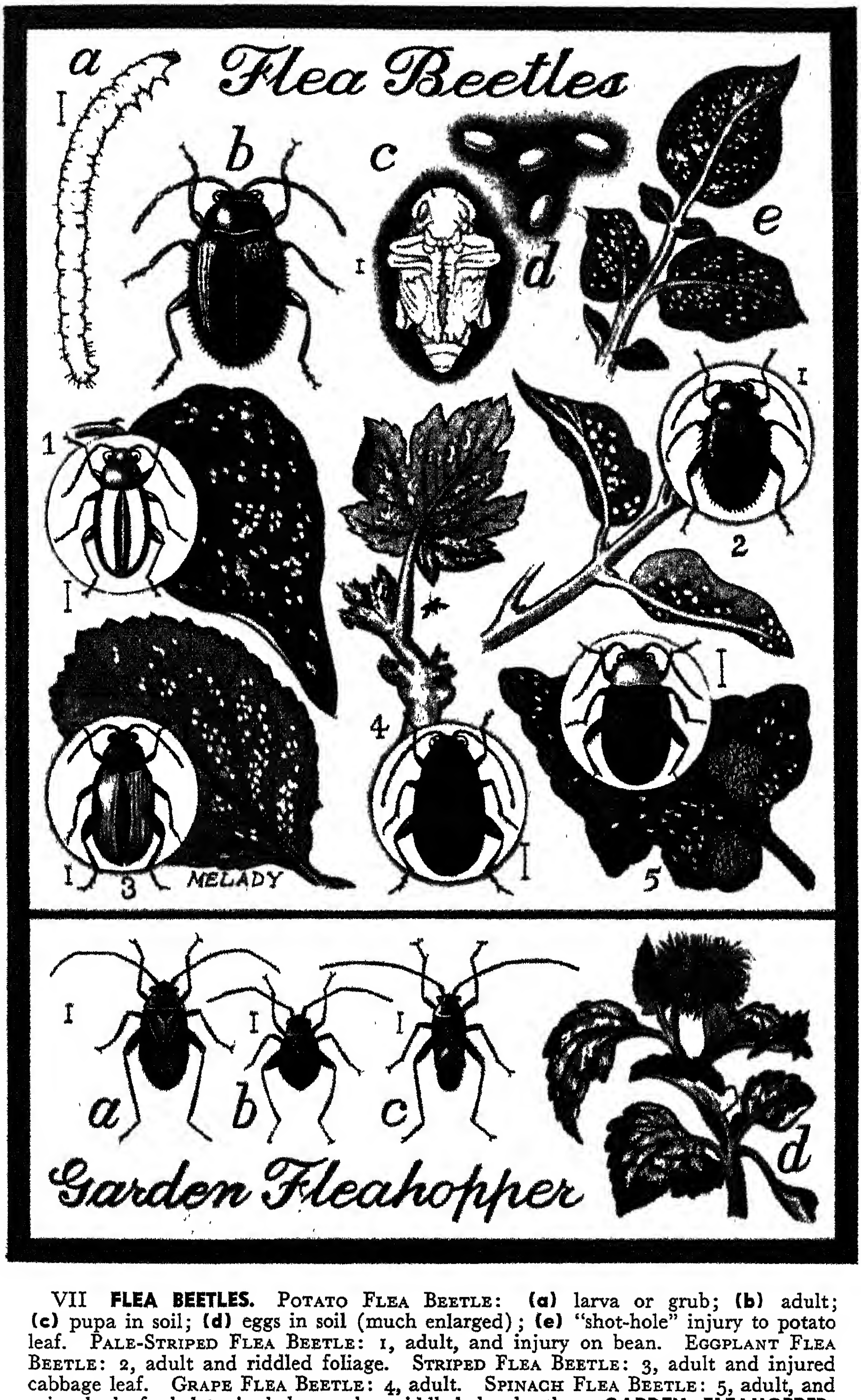
Rose Curculio—See under **Curculios.**

Rose Leaf Beetle (*Nodonota puncticollis*)—A small, shiny green to blue beetle resembling a flea beetle, though not so active. It is distributed from New England south and west to Arizona and Montana. Besides rose, it feeds on apple, scarring the fruit; and on grape, pear, plum, peach, raspberry, strawberry, and willow. When abundant, the beetles eat into rosebuds and partly expanded flowers enough to prevent blooming. They feed in spring on clover and other meadow plants before migrating to rose or fruits.

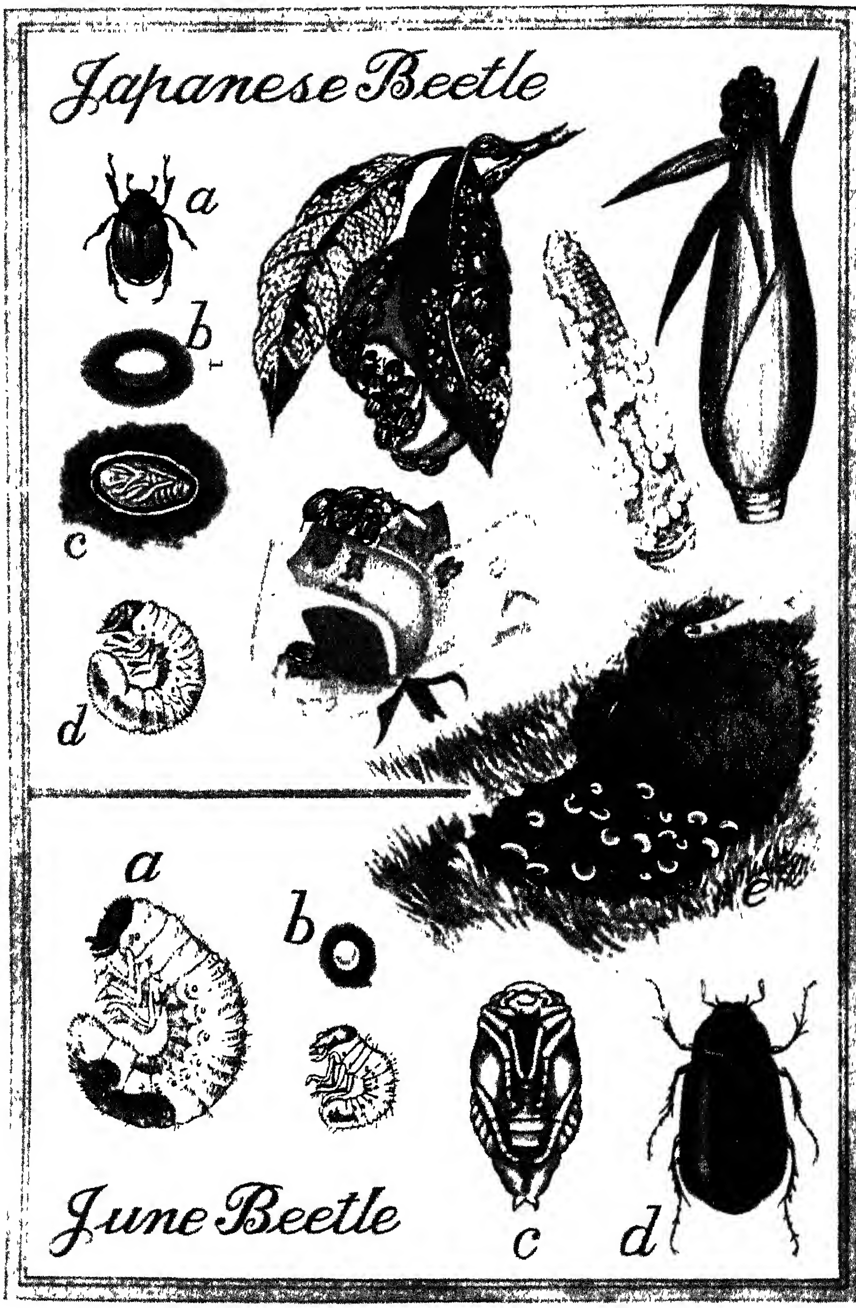
Lead arsenate gives adequate control when needed.

Roundheaded Apple Tree Borer—See under **Borers.**

ROVE BEETLES (family Staphylinidae)—A large family of beetles having slender bodies, very short elytra, and a habit of elevating the abdomen when disturbed. They are classed as beneficial to mankind, most of them being scavengers on decaying organic matter, some predaceous on other insects, and some true parasites. One species, *Somatium oviformis*, known as the red spider destroyer, is a very small, slender black beetle which lays orange eggs on surface of leaves. The larvae are yellow, about 1/8



VII **FLEA BEETLES.** POTATO FLEA BEETLE: **(a)** larva or grub; **(b)** adult; **(c)** pupa in soil; **(d)** eggs in soil (much enlarged); **(e)** "shot-hole" injury to potato leaf. PALE-STRIPED FLEA BEETLE: 1, adult, and injury on bean. EGGPLANT FLEA BEETLE: 2, adult and riddled foliage. STRIPED FLEA BEETLE: 3, adult and injured cabbage leaf. GRAPE FLEA BEETLE: 4, adult. SPINACH FLEA BEETLE: 5, adult, and spinach leaf skeletonized by grubs, riddled by beetles. **GARDEN FLEAHOPPER:** **(a)** long-winged female; **(b)** short-winged female; **(c)** male; **(d)** ageratum with foliage yellowed from loss of sap.



VIII **JAPANESE BEETLE:** **(a)** adult, with injury on peach, rose, and corn; **(b)** egg in soil (enlarged); **(c)** pupa in soil; **(d)** grub; **(e)** grubs with damage to turf. **JUNE BEETLE:** **(a)** white grub (larva) (full size); **(b)** egg (enlarged), and young larva; **(c)** pupa; **(d)** adult.

inch long, and consume about 20 mites apiece a day. The beetles are numerous on foliage of deciduous fruit and citrus trees infested with common red spider, two-spotted mite, European red, and other mites in Oregon and California.

Another species, *Coprochara bilineata,* is the dominant parasite of pupae of cabbage maggots, often destroying about 35 per cent.

Seed-corn Beetle (*Agonoderus lecontei*)—Sometimes the cause of corn failing to sprout. The beetles are dark brown and striped, or chestnut-brown, ¼ inch long, distributed throughout the greater part of the country. They are injurious chiefly where seed of low vitality has been used, or when cold weather has delayed germination.

Use good seed and delay planting until warm weather assures quick germination.

Shot-hole Borer—See under **Borers.**

Sinuate Pear Tree Borer—See under **Borers.**

Sinuate-striped Flea Beetle (*Phyllotreta zimmermanni*)—Much like the striped flea beetle but with a waxy stripe. The eggs are laid singly on leaves of cabbage, turnip, and radish, and the larvae mine inside the leaves.

Smaller European Elm Bark Beetle (*Scolytus multistriatus*)—Most famous as the vector of the fungus causing Dutch elm disease. (Plate X, page 142.) This bark beetle was first reported in Massachusetts in 1909 and was probably there several years before that. It is now known in southwestern New England, New York, New Jersey, eastern Pennsylvania, south to the southern boundary of Virginia, in West Virginia, and at many points in the Ohio River Valley.

The beetle is shiny, reddish-black, 1/10 to ⅛ inch long, the female slightly larger than the male. Both sexes have a tooth-like projection from the undersurface of the abdomen, serving to distinguish this species from other bark beetles. The grub is white, legless, ¼ inch long, much larger at the head end, and somewhat curved in its natural position. The beetles attack sickly, dying, and recently dead elms and logs by boring small holes through the bark to the sapwood, throwing out sawdust. Each female tunnels out a brood gallery from 1 to 2 inches longitudinally in the wood, and lays from 80 to 140 eggs along this gallery. The grubs on hatching make larval tunnels going out at right angles from the egg gallery so that characteristic engravings are made in the wood and inner surface of the bark. If many beetles enter the tree the limb or trunk is completely girdled and the bark separated from the wood all around.

The grubs transform into beetles in the larval galleries, and exit through small holes, looking like shot holes, in the bark. After emergence the beetles fly to healthy trees and feed by gnawing at the crotches of small

twigs, before making brood chambers in older wood. The spores of the Dutch elm disease fungus are formed in the galleries in the wood and cling to the beetle when it emerges. In feeding on twigs the beetles inoculate healthy elms with the fungus. There are normally two broods, beetles of the first appearing in May; adults of second in late August and September.

The smaller European elm bark beetle originally brought the elm fungus to this country. Live beetles arrived in elm burls used for furniture veneer, and more recently have been intercepted, by quarantine examination, in dish crates made of elm wood.

Control. All dead and dying elms should be cut and burned before beetles emerge in spring. Dying branches should be cut out and burned. Trees should be sprayed with lead arsenate to prevent defoliation and consequent weakening from cankerworms and elm leaf beetles. Trees should also be kept properly fed and watered so they will stay vigorous.

SOLDIER BEETLES (family Cantharidae), also called **Leather-winged Beetles**—They are slender, with leathery wing covers. Many are predators on aphids; some species feed on larvae of moths and beetles and on grasshopper eggs; others feed on pollen and nectar.

Southern Pine Beetle (*Dendroctonus frontalis*)—A small bark beetle attacking healthy, injured, and felled trees of pine and spruce from southern Pennsylvania south into Florida and west to eastern Texas and Arkansas. There are a number of natural parasites, including nematodes and mites.

Southwestern Pine Beetle (*Dendroctonus barberi*)—Very dark brown or black, making winding transverse egg galleries. It commonly attacks yellow pine in New Mexico, Arizona, Colorado, Utah, Nevada, and California.

Spinach Flea Beetle (*Disonycha xanthomelaena*)—The largest of the common flea beetles, 1/5 inch long, with greenish-black wing covers, yellow thorax, and black head. It feeds exposed on leaves and eggs are laid in clusters on leaves. The larva is a gray wrinkled grub about 1/4 inch long. Pupation is in the soil and there are one or two generations a year.

Spotted Asparagus Beetle (*Crioceris duodecimpunctata*)—Introduced into Europe a few years after the common asparagus beetle, first seen near Baltimore in 1881, and now distributed over much the same territory east of the Mississippi, but not in western asparagus fields. It occurs only on this host. The beetles may be very destructive but the larvae feed solely on berries. (Plate IV, page 111.)

The beetle is reddish-orange or tan, with 6 prominent black spots on each wing cover, for which reason it is usually called the twelve-spotted asparagus beetle. Greenish eggs are laid just before the berries form and

are glued singly along their sides to the leaves. Orange larvae, appearing in a week or two, bore into developing berry and eat pulp and seeds. Each larva destroys 3 or 4 berries before pupating in soil. Beetles of the new brood emerge in July and lay eggs for the overwintering generation appearing in September.

Control. In small garden gathering and burning berries are sufficient control. Spray same as for asparagus beetle, if necessary.

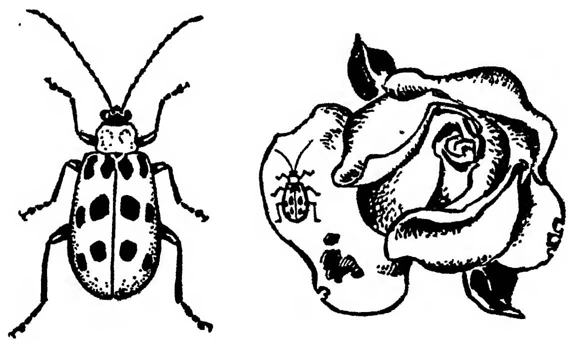


Figure 40

Spotted cucumber beetle, or Diabrotica, and injury to rose

Spotted Cucumber Beetle (*Diabrotica duodecimpunctata*) or **Southern Corn Rootworm**—Present anywhere in the United States east of the Rockies and a serious pest from Maryland to Ohio and Illinois and south to the Gulf states. A similar pest, the western spotted cucumber beetle, replaces this species west of the Rocky Mountains. The beetle is greenish-yellow with 12 black spots, black head, 1/4 inch long. (Figure 40.) Although probably not so injurious to cucumbers as the striped cucumber beetle, it far surpasses it as a general feeder on more than 200 plants.

In the larval or rootworm stage the spotted beetle injures corn, cereals, and grasses, and as an adult feeds on fruits, and on many flowers—chrysanthemum, coreopsis, cosmos, dahlia, impatiens, morning glory, rose, Shasta daisy, sweet pea, zinnia, to name only a few favorites. Vegetable food plants include snap and lima beans early in the season, all of the cucurbits—cucumber, melon, squash, gourds—and asparagus, beet, cabbage, eggplant, peas, potato, and tomato.

The spotted cucumber beetle hibernates as an adult at the base of weeds or other overwintering plants, and starts flying about as soon as the temperature reaches 70° F. in spring. The females lay eggs just below ground, on or near young corn plants, the young grubs feeding on roots and boring into underground parts of stem. These larvae are more wormlike than most beetle grubs, 1/2 to 3/4 inch long, slender with yellowish-

white wrinkled bodies and brown heads. They are sometimes called overflow worms or budworms or drillworms, because they bore out the crown of the corn plant and kill the bud. Corn injured in this way either breaks off or is dwarfed and yellowish. The number of generations varies from one and a partial second in the North to three and a partial fourth in the South. Most of the rootworm injury comes from the first generation.

This spotted beetle is known to harbor the bacteria of cucurbit wilt in its intestines, and to inoculate cucumbers and related plants as it feeds.

Control. Avert damage to corn by planting late in the season, thoroughly cultivating the soil first, and by not planting corn where a legume crop was last grown. Reduce overwintering beetles by cleaning up weeds, burning over waste places. Protect vegetables with rotenone sprays or dusts or, in some states, cryolite. Cryolite or barium fluosilicate dusts are useful for flowers afflicted with this pest, and DDT offers some future hope. Pyrethrum sprays will kill those beetles actually hit.

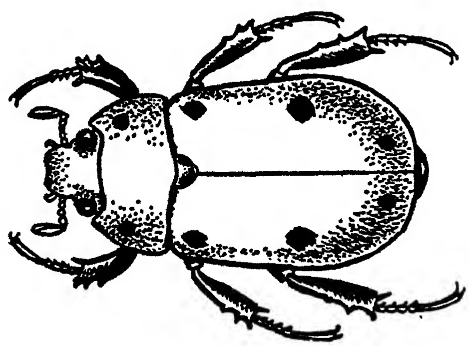


Figure 41

Spotted grapevine beetle

Spotted Grapevine Beetle (*Pelidnota punctata*)—A large beetle looking more dangerous than it actually is. It is conspicuous on grape foliage in summer, and is more than an inch long, broad, tan, glossy, with black spots around outer edge of elytra. (Figure 41.) It causes relatively little injury to grape leaves. Grubs live in decaying wood.

Control is unnecessary.

Squash Beetle (*Epilachna borealis*)—Sharing with the Mexican bean beetle the dubious distinction of being a gangster member of the usually beneficial ladybeetle group. It is a common pest east of the Rocky Mountains on squash, melon, pumpkin, and relatives, but is not nearly so destructive as the Mexican bean beetle which it closely resembles. It is a little larger, is yellow with 7 black spots on each wing cover. Beetles emerge in June to lay eggs on host plants. These hatch in a week. The

spiny larva feeds on foliage for 2 to 4 weeks, then pushes its larval skin down over the back while it pupates. The beetles hibernate under trash of any kind.

Rotenone is probably the best spray or dust to use in the small garden.

Steel-blue Flea Beetle (*Altica torquata*)—A small, metallic blue or purple beetle abundant on grapes in New Mexico, Arizona, and southern California. Native hosts are desert and evening primroses.

Steel-blue Ladybeetle (*Orcus chalybeus*)—A very small, metallic steel-blue or emerald-green beetle. It was introduced into California from Australia in 1892 to prey on black, red, and purple scales, and is now present in numbers in citrus orchards in a few localities. See Ladybeetles.

Strawberry Flea Beetle (*Altica ignita*)—Metallic green, golden-bronze or purple, feeding on strawberry, kalmia, evening primrose, fuchsia, and other plants.

Strawberry Root Weevil—See under **Weevils.**

Strawberry Weevil—See under **Weevils.**

Striped Blister Beetle (*Epicauta vittata*)—Black with a yellow border and median stripe on each wing cover, just over ½ inch long. It is a very common species ranging west as far as Montana and reported as occurring in large swarms in Arkansas, both in alfalfa fields and in vegetable gardens. There can be several hundred blister beetles in a square foot of area. It feeds on bean, beet, corn, melon, peas, potato, radish, tomato, turnip, and other vegetables.

Control. Dusting vegetables with derris dust of at least 2 per cent rotenone content has given good results.

Striped Cucumber Beetle (*Diabrotica vittata*)—A native insect, the most serious cucumber pest east of the Rocky Mountains. A related species takes over cucurbit destruction in the West. The larvae feed only on the roots of cucumber, muskmelon, winter squash, pumpkin, gourds, summer squash and watermelon about in the order named, but the beetles feed also on beans, peas, corn, and blossoms of other plants.

The beetles are yellowish with 3 black stripes, ⅕ inch long. As unmated adults they spend the winter in woodlands near the vegetable garden under leaves or rotting logs, in lowland hedgerows, or near wild food plants such as goldenrod and aster, but nearly always keeping in direct contact with the ground. They become active in spring when the temperature gets above 55° F. Before cucurbit plants are up they feed on pollen, petals or leaves of buckeye, willow, wild plum, hawthorn, thorn apple, apple, elm, syringa, and other plants, but settling on young cucumber and related vines as soon as they appear above ground. Mating takes place as they feed on the vine crops, with the female laying orange eggs in or on the soil at the base of these plants. (Plate XII, page 143.)

The worm-like larvae, 1/3 inch long, very narrow, feed on roots and underground parts of stems for 2 to 6 weeks, often destroying the whole root system with consequent death of vines. The pupa is white, formed in the soil. Adults appear in midsummer to feed on cucurbits and legumes for another 6 weeks, often eating into the rind of fruits as well as chewing leaves. In the North there is only one generation, but in the South there may be a partial third, or even fourth.

These beetles transmit bacterial wilt of cucurbits and cucumber mosaic. In my own garden they are frequently found in spring on Chinese lantern, the leaves of which are often mottled with the mosaic pattern, and the lantern is such a vigorous grower it is hard to eradicate it entirely before the beetles carry the mosaic to the vine crops.

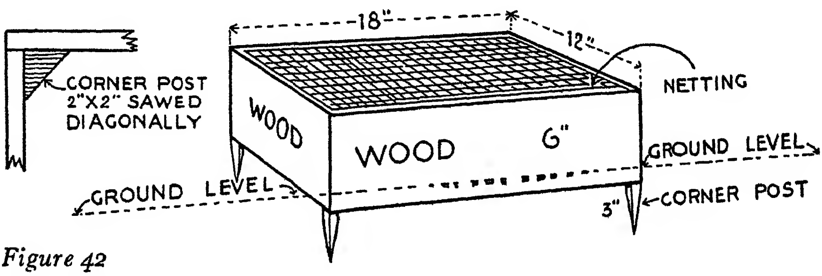


Figure 42

Diagram of a box used to protect young vine crops from beetles

Control. Early feeding by beetles can be avoided by starting the plants under hotkaps. Figure 42 shows the protective device used by the Rockwells at GrayRock after the vine crops get too big for hotkaps. Boxes 18 inches by 12 inches are built, open top and bottom, the 4 sidepieces firmly nailed to stout corner posts, sharpened to points at the lower ends and each post extending 3 inches below the bottom of the box. The top is covered with stout mosquito netting or wire. After the boxes are pushed into place over the young plants soil is banked around the sides to keep out all insect pests.

When the vines grow too large for the boxes, dust them weekly with rotenone, perhaps combined with copper in a special cucurbit mixture that is a combination insecticide-fungicide. Do not use sulfur in combinations for cucurbits. Sometimes cryolite or calcium-arsenate sprays or dusts are satisfactory.

Striped Flea Beetle (*Phyllotreta vittata*)—Widely distributed pest of cabbage, 1/12 inch long, with a crooked yellowish stripe on each wing cover. Eggs are laid in small cavities gnawed in the stem. See Flea Beetles.

SWEETPOTATO BEETLES—See **Tortoise Beetles.**

Sweetpotato Flea Beetle (*Chaetocnema confinis*)—Very small, 1/16 inch long, black with a bronzy reflection. It eats narrow grooves in the leaves along the veins. Leaves wilt, plant turns brown. The beetle infests besides sweet potato, morning glory, sugar beet, raspberry, boxelder, corn, cereals, grasses. The larvae feed on roots of bindweed. Spray plant in seedbed with lead arsenate.

Sweetpotato Leaf Beetle (*Typophorus viridicyaneus*)—A metallic blue-green, oblong-oval beetle, a little over 1/4 inch long, which eats tender leaves at the crown of the plant, devouring them from the inner margin outward.

Ten-lined June Beetle (*Polyphylla decemlineata*)—Robust, brown, covered with yellowish and white scales, the latter arranged to make two stripes on the head, 3 on the thorax, and 4 long and 1 short stripe on each wing cover. Larvae are very large white grubs up to 2 inches long. This June beetle occurs primarily in the Rocky Mountain states and the Southwest, with a very similar species (*P. crinita*) along the Pacific coast. Larvae may girdle and destroy roots of ornamental shrubs and deciduous fruit nursery trees. They are reported working on California privet, black locust, and wisteria.

Three-lined Potato Beetle (*Lema trilineata*)—A yellow leaf-eating beetle with 3 black stripes, about 1/4 inch long. Occasionally the feeding on potato may be injurious but not when foliage is treated with arsenicals against the Colorado potato beetle. The larvae have the peculiar habit of protecting themselves by plastering granular masses of their own excrement over their bodies.

TIGER BEETLES (family Cincindelidae) are named for their predaceous habits and because some species have white or yellowish stripes on brilliantly metallic-blue or green wing covers. Many forms are semi-aquatic. They are usually found along waterways and are considered among the beneficial beetles. They feed on a wide variety of insects and small animals. The larva is as ugly as the adult is beautiful, and just as rapacious. It is a long and ungainly grub with a heavily chitinized head and a hump attached to the fifth segment of the abdomen. Little hooks are attached to this hump, by means of which the larva clings firmly to the soil while dragging some struggling larger insect down into its burrow, dug in the sand.

Tobacco Flea Beetle (*Epitrix parvula*)—Very small, reddish to dark brown, often with a dark transverse band across the elytra. It is most injurious to solanaceous plants—tobacco, tomato, potato, groundcherry, eggplant, and related weeds, but it also feeds on almond, orange, and squash. It occurs throughout the country, hibernates as an adult, and may have two or more generations a year. See Flea Beetles.

TORTOISE BEETLES, sometimes called sweetpotato beetles or goldbugs. They comprise several species distributed over the United States and feeding on members of the morning glory family, especially sweet potato, morning glory, bindweed. They are leaf-eaters, relatively small, none over ¼ inch long, nearly as wide as long, and the margins of the body are extended to hide the head and most of the legs, making them look like tortoises. They eat holes through the leaves, or devour entire leaves, sometimes seriously injuring newly set plants. They winter as beetles in dry, sheltered places, under bark or trash, coming out of hibernation late, feeding and mating on plants in May and June.

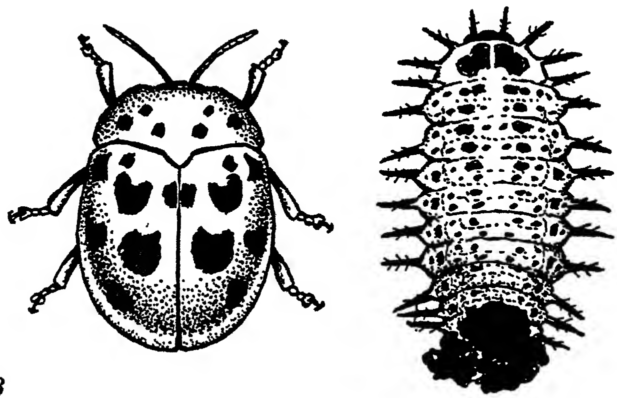


Figure 43

Argus tortoise beetle, and larva showing mass of excrement held on spines

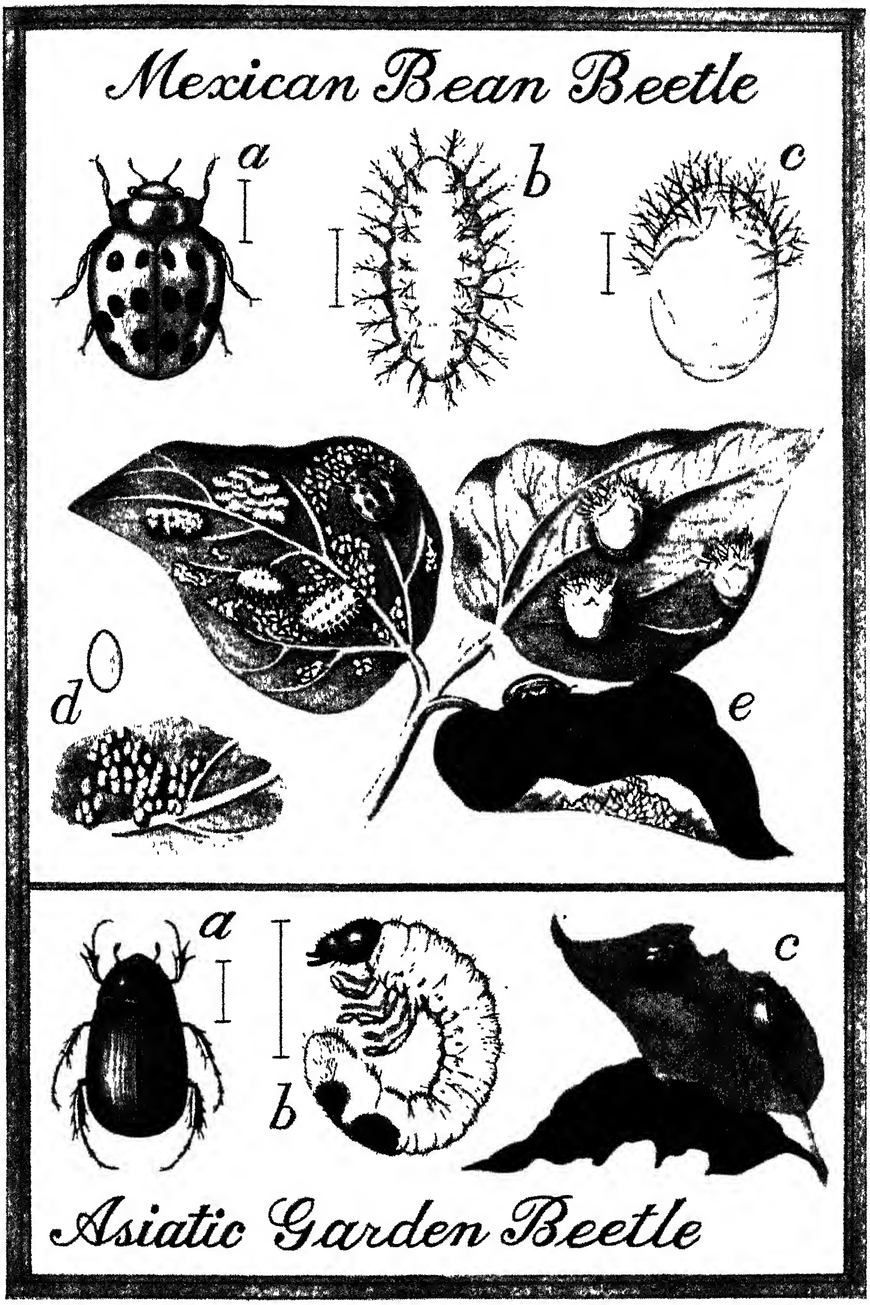
The larvae are about ⅜ inch long, and have conspicuous horny spines all around the margin, 2 at the posterior end being nearly as long as the body. (Figure 43.) On these posterior spines the larva packs its own excrement and cast skins from molting, then curls them over its back like a squirrel's tail. The larvae look like moving bits of dirt. When full-grown the larvae fasten themselves to leaves, pupate, and produce beetles in August ready for winter.

Spraying with lead arsenate or cryolite in seedbed or garden gives good control.

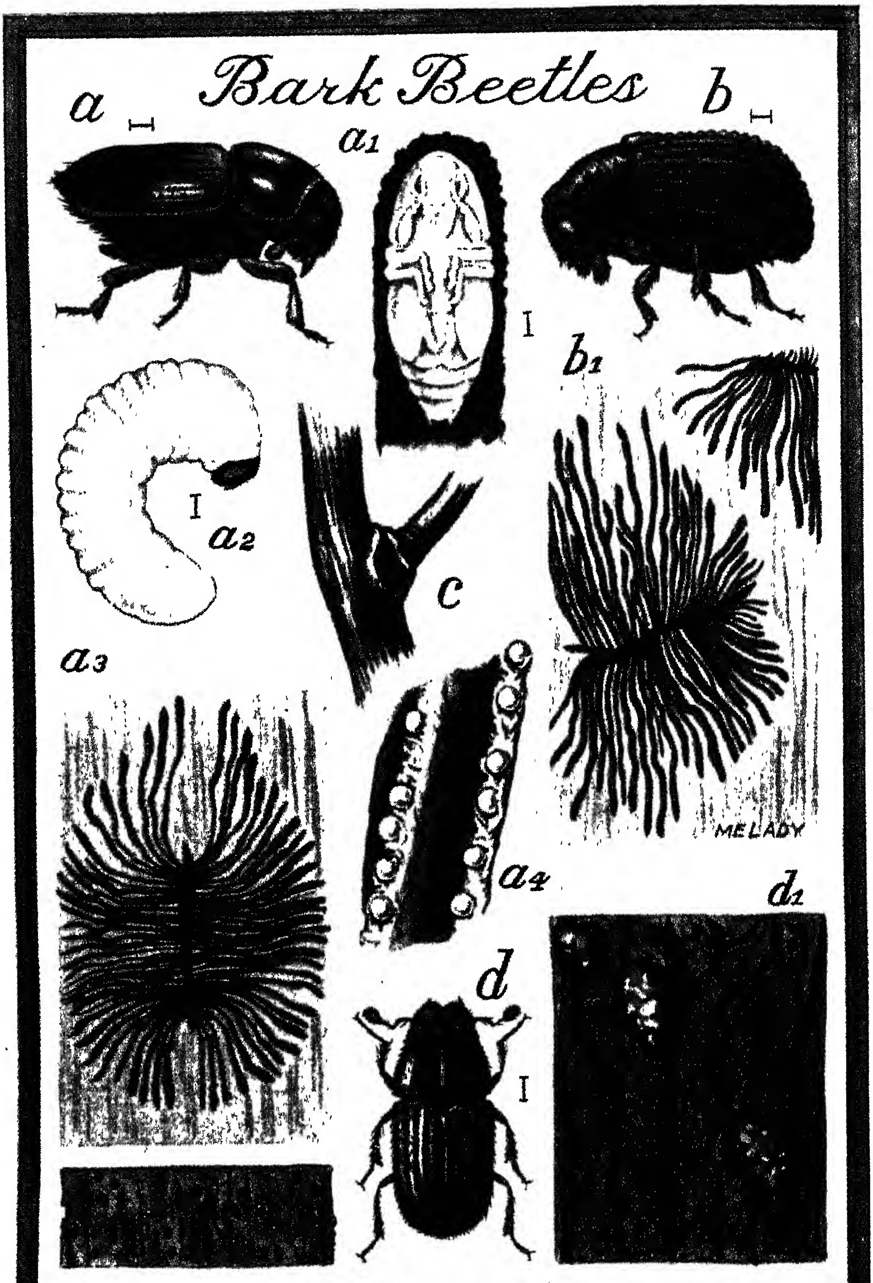
The Argus Tortoise Beetle and the Golden Tortoise Beetle have been treated separately. Other representative forms are:

Black-legged Tortoise Beetle (*Jonthonota nigripes*)—Golden-yellow, with 3 small black dots arranged in a triangle on each wing cover; larvae straw-yellow with 2 dark spots behind the head. Excrement on long spines is drawn out sideways in long shreds.

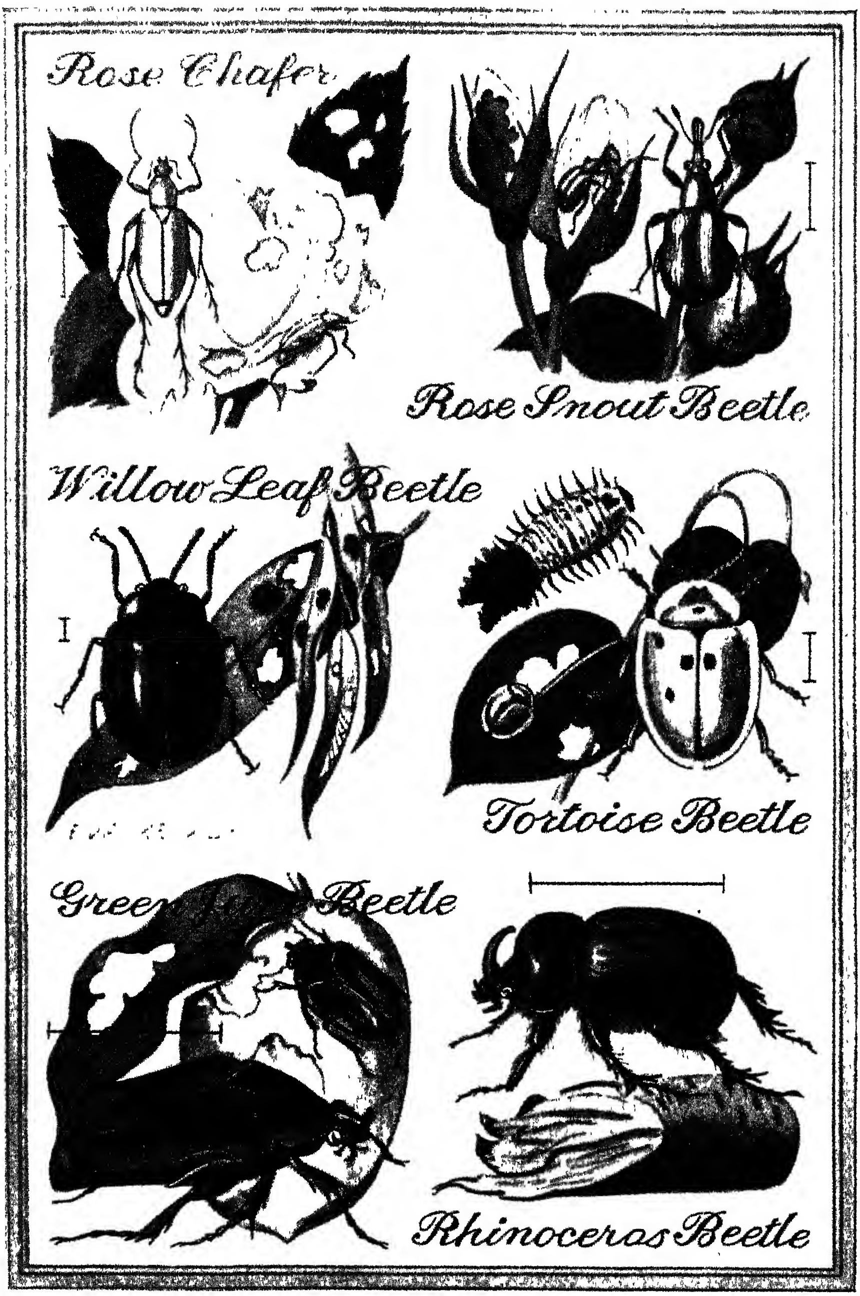
Mottled Tortoise Beetle (*Deloyala guttata*)—Golden around the mar-



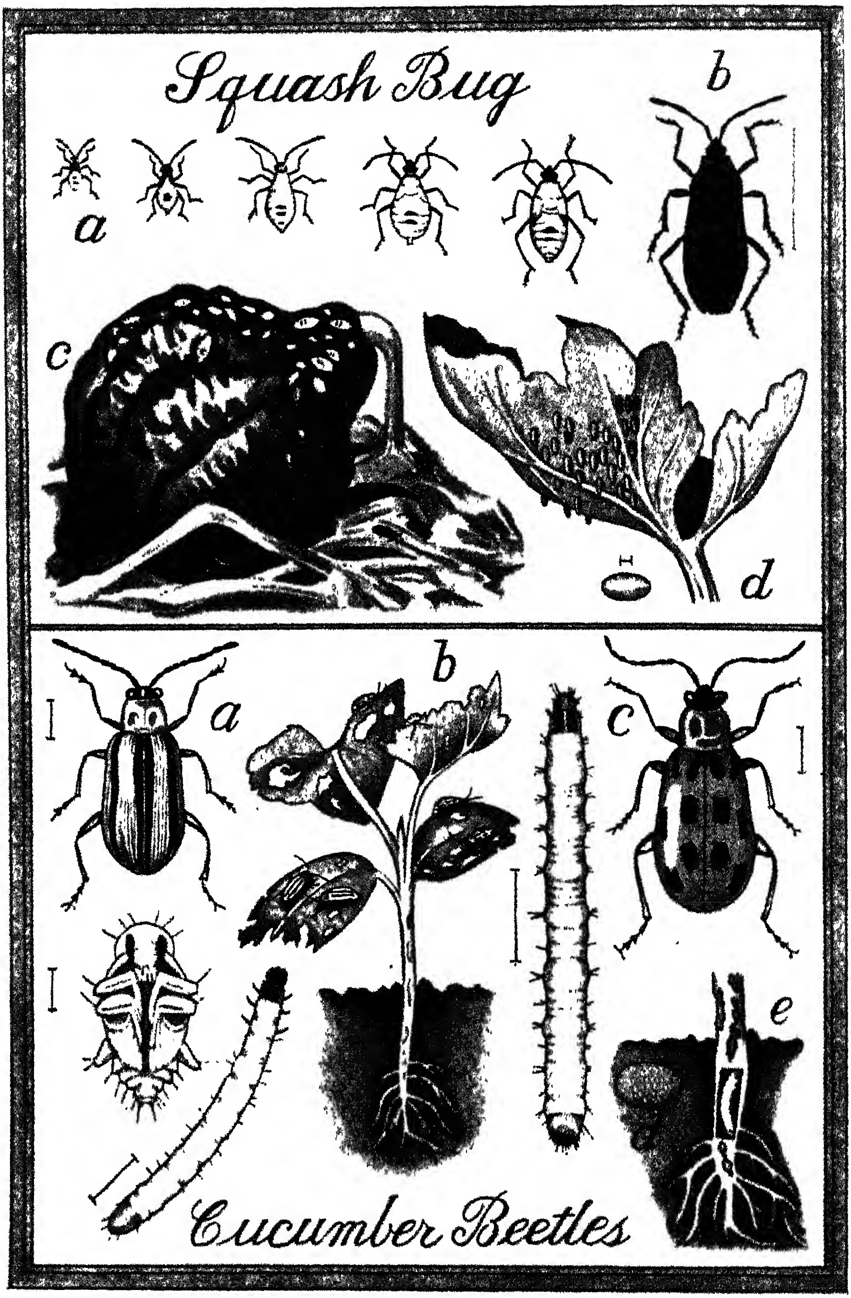
IX **MEXICAN BEAN BEETLE:** **(a)** adult; **(b)** grub (larva); **(c)** pupa showing larval skin pushed back at one end; **(d)** egg cluster on back of leaf and single egg (enlarged); **(e)** bean leaf showing beetle in all stages and feeding pattern (skeletonization). **ASIATIC GARDEN BEETLE:** **(a)** adult; **(b)** grub; **(c)** beetles, natural size, feeding on foliage.



X **SMALLER EUROPEAN ELM BARK BEETLE:** **(a)** adult; **(a1)** pupa; **(a2)** larva; **(a3)** characteristic pattern of galleries and (*below*) bark with typical exit holes; **(a4)** eggs lining gallery (much enlarged); **(c)** feeding injury at crotch. NATIVE ELM BARK BEETLE: **(b)** adult; **(b1)** galleries in usual transverse position. WESTERN PINE BEETLE: **(d)** adult; **(d1)** pine bark showing resin tubes formed around entrance holes and small exit holes.



XI **ROSE CHAFER:** beetle (natural size) feeding on rose (somewhat enlarged). **ROSE SNOUT BEETLE:** beetle feeding on rose and same enlarged. **WILLOW LEAF BEETLE:** willow leaves showing skeletonization by larvae, holes eaten by adults, and single beetle (much enlarged). **BLACK-LEGGED TORTOISE BEETLE:** adult, natural size, feeding on leaf and same enlarged; black-spined larva with excrement piled on back. **GREEN JUNE BEETLE:** adult, actual size, feeding on fruit and foliage, and same enlarged. **RHINOCEROS BEETLE.**



XII **SQUASH BUG:** **(a)** nymph in successive stages or instars; **(b)** adult winged bug; **(c)** nymphs feeding on squash; **(d)** eggs grouped on underside of leaf, and single egg (enlarged). **STRIPED CUCUMBER BEETLE:** **(a)** adult, pupa and grub; **(b)** adults feeding on seedling. **SPOTTED CUCUMBER BEETLE:** **(c)** adult and larva or rootworm; **(d)** egg (enlarged) in soil; **(e)** rootworm larva in underground corn stem.

gin, the rest mottled black and yellow; larvae dull green, bluish along the back, and covered with broad branching masses of excrement.

Striped Tortoise Beetle (*Cassidea bivittata*)—Dull yellow, with 5 longitudinal black stripes; larvae are yellowish-white with a gray line; short marginal spines and a tail-like projection bearing shed skins but no excrement. White eggs are laid on leaf stems or veins, each one covered with a daub of black pitch for protection.

Vegetable Weevil—See under **Weevils.**

Watercress Leaf Beetle (*Phaedon aeruginosus*)—Small, bronze-black beetle, about 1/8 inch long; larva brownish-black with many tubercles of hairs. There seems to be no satisfactory control.

Waterlily Beetles (*Donacia palmata, D. piscatrix, Galerucella nymphaeae*)—The first 2 species are small, metallic bluish or brownish, the third is dull brown. They feed on leaves or flowers. Submerging the plants by weights on the leaves will help get rid of the beetles. If there are no fish in the pool, leaves can be dusted lightly or have a fine mist spray of lead arsenate.

Western Black Flea Beetle (*Phyllotreta pusilla*)—Very small, shiny olive-green or black, often appearing in swarms on cabbage, cauliflower, horseradish, mustard, radish, watercress, peppergrass, turnip, sugar beet, corn. This beetle is found in states on the east slope of the Rocky Mountains and also in Arizona, California, Colorado, Montana, Nevada, New Mexico, Texas, Wyoming.

Western Pine Beetle (*Dendroctonus brevicomis*)—The most destructive pest of pines in the West and responsible for tremendous annual losses. The adults are small, pale brown to black bark beetles, which construct winding egg galleries between bark and sapwood, the larval galleries penetrating outward into middle layers of bark. When healthy trees are attacked, resin tubes are formed about the entrance holes. When the beetles emerge, exit holes may cover the bark. Pine needles are reddened. Western yellow and sugar pines are attacked in western Nevada, Wyoming, Montana, Oregon, Washington, and northern and central California. This is chiefly a forest tree insect, though it may occur in home gardens.

Western Potato Flea Beetle (*Epitrix subcrinita*)—Shiny bronze, 1/16 inch long, injuring most seriously potatoes and tomatoes but also attacking about the same list of plants as the potato flea beetle. The western species is found in Arizona, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, and Washington.

Western Spotted Cucumber Beetle (*Diabrotica soror*)—Replacing the spotted cucumber beetle west of the Rocky Mountains. It has the same greenish-yellow wing covers, but is slightly smaller, has somewhat larger

black spots. Soon after native grasses dry up in pastures the adults appear and swarm into the garden, devastating flowers, lawns, ornamental trees and shrubs, truck crops, fruit trees—in fact, nearly every green plant except the conifers. This pest is called diabolical Diabrotica by irate gardeners.

The larvae feed on roots of corn and sweet peas as well as native grasses. Beetles eat holes in ripening fruit, especially in orchards in uncultivated areas, and spread the fungus causing brown rot of apricots, peaches, and other stone fruits.

Control. A pyrethrum-thiocyanate dust has been used effectively and safely on trees with ripening fruit. Beans, often attacked in great numbers, are protected by a 50 per cent cryolite dust or the fruit dust consisting of 0.1 per cent pyrethrins and 1 per cent Lethane in talc. The latter dust is also suitable for cucumbers and melons.

Larvae can be killed by pouring a cup of nicotine-sulfate solution, 1 teaspoon per gallon, on the roots. For dahlias and other ornamentals try cryolite or barium fluosilicate, or screen choice blossoms with cheesecloth. A 1 per cent rotenone dust is also satisfactory, and a pyrethrum spray is useful on flowers.

Western Striped Cucumber Beetle (*Diabrotica trivittata*)—Like the eastern species with yellow body and 3 black stripes, but the basal portion of the antenna is yellow instead of black. It is most abundant and injurious in southern California but ranges into Arizona and Oregon. The larvae attack roots of cucumber, melon, pumpkin, squash, and other cucurbits, while the adults feed on tops of these plants and also bean, beet, corn, pea, sunflower, almond, apple, prune, and some other plants.

Use the same control measures as for the Western spotted cucumber beetle.

Western Striped Flea Beetle (*Phyllotreta ramosa*)—Shiny black with a brassy reflection and a conspicuous irregular yellow-white band down each wing cover; 1/16 inch long. It may be destructive to cabbage, cauliflower, brussels sprouts, radish, rape, mustard, stocks, turnip, wallflower, watercress, and other crucifers in California.

WHIRLIGIG BEETLES (family Gyrinidae)—A small family of oval black beetles whirling about on surface of ponds or streams, feeding on any small insects that fall into the water.

White-fringed Beetle (*Pantomorus leucoloma*)—A recently introduced pest, first seen in Florida in 1936. It is a native of South America, where it is widely distributed over the southern half, and has also been reported from Australia. To date, its range in the United States extends from western Florida along the Gulf to eastern Louisiana (resulting in a Federal Quarantine for the states of Alabama, Florida, Louisiana, and

Mississippi), and an infestation in North Carolina. In the quarantined states only certain areas where the beetle has been found are regulated, so that one garden or nursery may be under quarantine and another a few miles away is not. The beetle does not fly, so there is not so much danger of natural spread as with Japanese beetles. (Figure 44.)

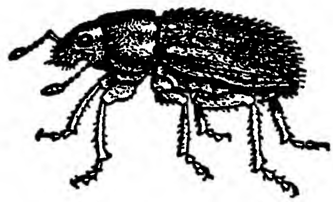


Figure 44

White-fringed beetle

The white-fringed beetle is grayish, with faint white stripes, covered with fine short hairs, with a long head; about ½ inch long. It is gregarious, as many as 200 or 300 beetles being found on one plant eating in from the margins of the leaves or crawling along the ground. There are more than 50 different host plants, including herbaceous weeds, vines, trees, and crop plants such as velvet beans, cabbage, chufa, collards, corn, cotton, cowpea, sugar cane, sweet potatoes, and blackberries.

The beetle winters as a grub, usually in the upper 9 to 12 inches of soil, but sometimes as far down as 24 inches. It changes to a white naked pupa, found in the top few inches of soil, from late May to July, the beetle appearing from the middle of June to the end of July. No males have been found; the females start to lay unfertilized eggs 10 to 12 days after emergence. One female may lay hundreds of eggs, the maximum observed being 1,847, deposited in gelatinous clusters at the base of plants or on stones, et cetera. The eggs hatch in 2 to 6 weeks, depending on temperature and moisture, and the larvae, small, white, legless grubs, feed below ground on lower stems, taproots, or seeds of garden plants, which turn yellow, wilt, and finally die.

Control. Although the wingless beetle does not fly it can crawl upward of a mile. Ditches a foot wide and deep will prevent migration. Nursery inspection and certification, sometimes methyl-bromide fumigation, prevent beetles or grubs being shipped with plants. Recent experiments indicate that DDT is effective in killing the white-fringed beetle.

White-pine Cone Beetle (*Conopthorus coniperda*)—Feeding, as a small grub, at the base of scales of pine or spruce cones and sometimes tunneling into young tips. Some of the tips are browned back a couple of inches, and cones may drop prematurely; but there is no permanent injury.

BIRDS

Birds are our friends in the garden not so much for utilitarian purposes as for the joy they bring us. I grant you that birds eat a great many insects, sometimes their total weight in a single day. In my own garden unlovely starlings do their good deeds by swarming over the lawn in search of beetle grubs, while sparrows flock on it for crabgrass seed. Many birds hover over the rose shoots all summer to collect aphids; brown thrashers take those hard-shelled Japanese beetles and wham them down on the cement walk until they are of edible consistence; downy woodpeckers have long since cleaned all the insects out of the pear tree bark and I have to offer other inducements to keep them around. I cheerfully turn over the entire cherry crop to keep a pair of cardinals calling my yard home; I am resigned to covering the strawberries with netting; and I did not even fuss when I found no way to protect the corn from grackles. In short, I love birds; I'll spend a good deal of time and money inducing them to stay and keep me company on winter days, but I do not expect them to do my garden work for me.

I know that, despite birds, I shall always have to spray and dust to protect my plants from noxious insects and that the beneficial insects in my garden will be of more dollars-and-cents value to me than the birds who eat them, along with the bad insects. As Dr. Lutz wrote in his *A Lot of Insects:* "Let us protect birds because they are pretty and sing sweetly and because they are a part of nature; but let us admit that, on the one hand, their value as destroyers of insects injurious to man has been grossly overestimated and, on the other hand, the value of insects as destroyers of our insect pests has been shamefully overlooked."

Amateur gardeners are frequently worried about the use of stomach poisons, such as lead arsenate, as they affect the garden population of birds. Here, too, the injury has been grossly overestimated. Poisoned caterpillars seem perfectly acceptable food for birds. Harmful effects from high-pressure tree spraying would be as much from the mechanical action of a strong stream of water knocking baby birds out of nests, as from the poison. If, after continued use of artificial-control measures, you have fewer birds in the garden, it does not mean you have killed them; you have merely starved them out by reducing the insect population so that they have gone on to more fruitful hunting grounds. One entomologist lists as one of the beneficial effects of insects the fact that they attract the birds we love to our gardens, which is quite different from the usual slant that we have to have the birds to get rid of the insects.

Frankly, no one knows enough yet to make authoritative statements

about the effect of DDT on birds. I went to a symposium on the subject recently. One arborist reported several birds dead under a tree that had been sprayed with DDT. The birds were autopsied—and found full of BB shot! A couple of small boys lived near that tree. Don't jump to conclusions too soon about poisons and birds!

The yellow-bellied sapsucker (*Sphyrapicus varius varius*) is one bird which really has to be listed as a pest, from its habit of making regularly spaced holes around a tree trunk for extraction of spring sap. Scotch pine seems most susceptible; a simple control measure is to wrap the trunk with burlap or tough paper during the time of heavy sap flow.

Crows probably balance their depredations with good deeds. Commercial crow repellents are on the market for treating seed, but opinions differ as to their efficacy. For fruits, the only protection from birds is to cover small trees or strawberry beds with netting, or to bag grape clusters.

BOLLWORMS

Bollworm is the name given to the larva of a moth devouring the unripe pods or bolls of cotton. The true bollworm (*Heliothis armigera*) is better known to gardeners as the corn earworm and is discussed under that name.

Pink Bollworm (*Pectinophora gossypiella*)—Considered one of the 6 most destructive insects in the world. It came to Mexico from Egypt in 1911, and by 1917 had reached Texas. It is now present in Arizona, Louisiana, New Mexico, and Texas, which states are under quarantine. Where established it causes a loss of one fifth to one half the cotton crop. It is spread on okra pods as well as plants, seeds, lint or waste products of cotton. Mallow, rose-of-sharon, abutilon, and hibiscus are occasional hosts.

The caterpillars are cylindrical, pinkish, sometimes remaining for more than a year curled up in seed, bolls, or in the soil. The moths are small, dark brown with narrow fringed wings, pointed at the tip. Worms can be killed in cottonseed by heat, but there is no really satisfactory control. Strict enforcement of quarantine is most necessary.

BORERS

Borers are grubs or caterpillars, larvae of beetles or moths, working in woody tissues or herbaceous stems. There are a great many borers affecting shade and fruit trees, ornamental shrubs, herbaceous annual and perennial plants. The proportion selected for inclusion in this manual is small compared to the total number.

Borers are particularly destructive to newly set trees, and to those weakened from drought, starvation, and other causes. One of the clearest discussions of the basic factors predisposing trees to borer attack, and the fundamentals of borer control, was given at the 1944 National Shade Tree Conference by arborist and entomologist Stanley W. Bromley. With Dr. Bromley's permission his remarks are summarized here:

Factors Predisposing Trees to Borer Attack

1. *Drought*—A fundamental factor; tree roots and rootlets are injured by excessive drying and entire tree is systemically weakened; volatile elements diffuse from bark and twigs to attract winged borer adults, especially hickory bark, elm bark, and pine bark beetles.

2. *Storm Injuries*—As shown in great increase in borers after 1938 and 1944 hurricanes, and severe ice storms.

3. *Lightning*—Injured trees attract borers, which finish what the lightning started.

4. *Winter Injury*—Weather conditions cause "winter drying," and resultant weakening.

5. *Defoliation by Leaf-eating Insects*—One of the most important invitations to borers. Defoliation of oaks by cankerworms, gypsy moths, or leaf rollers predispose trees to disastrous attacks by two-lined chestnut borer; pines defoliated by sawflies are subject to bark beetle invasions.

6. *Effect of Construction Activities*—Changes due to grading, filling, lowering or raising of water tables, mechanical injuries, blasting and related activities attendant on excavation, ditch digging, pipe laying, road building, or other construction work, may gravely weaken established trees.

7. *Chemical Injuries*—Street trees may be weakened by illuminating gas resulting from leaks in buried pipes, or have roots injured from chlorides applied to roads to lay dust. Smoke injury due to sulfur and other fumes has been more prevalent with increased use of soft coal.

8. *Fire-scorched Bark* invites borer attack not only in trees that have lived through forest fires, but when leaves are carelessly burned in bonfires under street trees.

9. *Carelessness of Wood Disposal*—Insects emerging from borer-killed trees are on hand to infest other trees. Elm logs are a prolific source of bark beetles, instrumental in spreading Dutch elm disease, and a real threat to live elms in the vicinity.

10. *The War* has meant gross neglect of fine old specimen trees. Prompt action is needed now that men and equipment are available.

Methods of Control

1. *Cutting Out*—A method to be used when there is no alternative, and limited to such borers as turpentine beetles and the pitch mass borer which can be taken out with little injury to coniferous hosts. The use of a wire in probing into holes for borers reduces the amount of bark cutting.

2. *Fumigation*—Effective in control of heartwood borers like the carpenter worm, leopard moth, poplar borer, sugar maple borer, carpenter ants, and similar insects which work deep in the heart of a tree and maintain galleries to the open air.

Chief fumigants are the cyanides—such as Cyanogas, which liberates a toxic vapor (hydrocyanic acid) on exposure to atmospheric pressure; and carbon disulphide, a malodorous liquid which volatilizes on exposure to air and is highly inflammable and explosive. Such gases quickly kill borers when introduced into tunnels, but *should not be used on trees of nursery size* because of likelihood of serious injury to the trees.

3. *Wrapping*—Wrapping newly transplanted trees with burlap is standard practice among nurserymen. The burlap prevents excessive evaporation and drying out of bark, reduces danger of sunscald, and protects against borer invasion. Trees with initial borer infestation may often be saved by wrapping with burlap, plus feeding and watering to promote vigor. The burlap promotes rapid bark healing, and the increased sap flow may kill young borers. Wrapping paper and composition materials may be substituted for burlap but seem, to Dr. Bromley, not so satisfactory for general use. However, when tree trunks infested with cambium borers were wrapped with adhesive tape, the trees recovered.

4. *Spraying*—A foliage spray of lead arsenate kills leaf-eating adults of some borers before they can lay eggs.

Lime-sulfur can be sprayed or painted on bark as a borer repellent. DDT offers promise as a repellent.

Antidessicant sprays, such as Dowax or Protex, aim at keeping a thin, waxy film over the trunk to prevent drying out and borer entry; their use is still somewhat experimental.

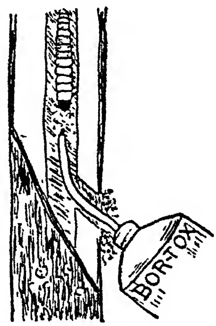
5. *Feeding*—Maintenance of vigor prevents borer attack and also rebuilds a tree which has been ravaged by borers; feeding, together with watering, may be the most important method of combating borers.

6. *Ether Emulsions*—Such pests as the pine root or Scotch pine weevil have been controlled by applying an ether emulsion to the base of the trunk—either dichloroethyl ether or dichloroisopropyl ether.

7. *Cutting and Burning*—The final step, when all attempts at control have failed, to protect neighboring trees from a like fate.

In addition to the treatments suggested by Dr. Bromley I have found the injection of nicotine paste, sold as Bor-Tox or Borerkil, helpful in small garden work as a fumigant for lilac borers and others which show their presence by the accumulation of sawdust and frass at holes on the trunk. This paste is safe on smaller trees and shrubs when other fumigants might be injurious. (See Figure 45.)

Figure 45

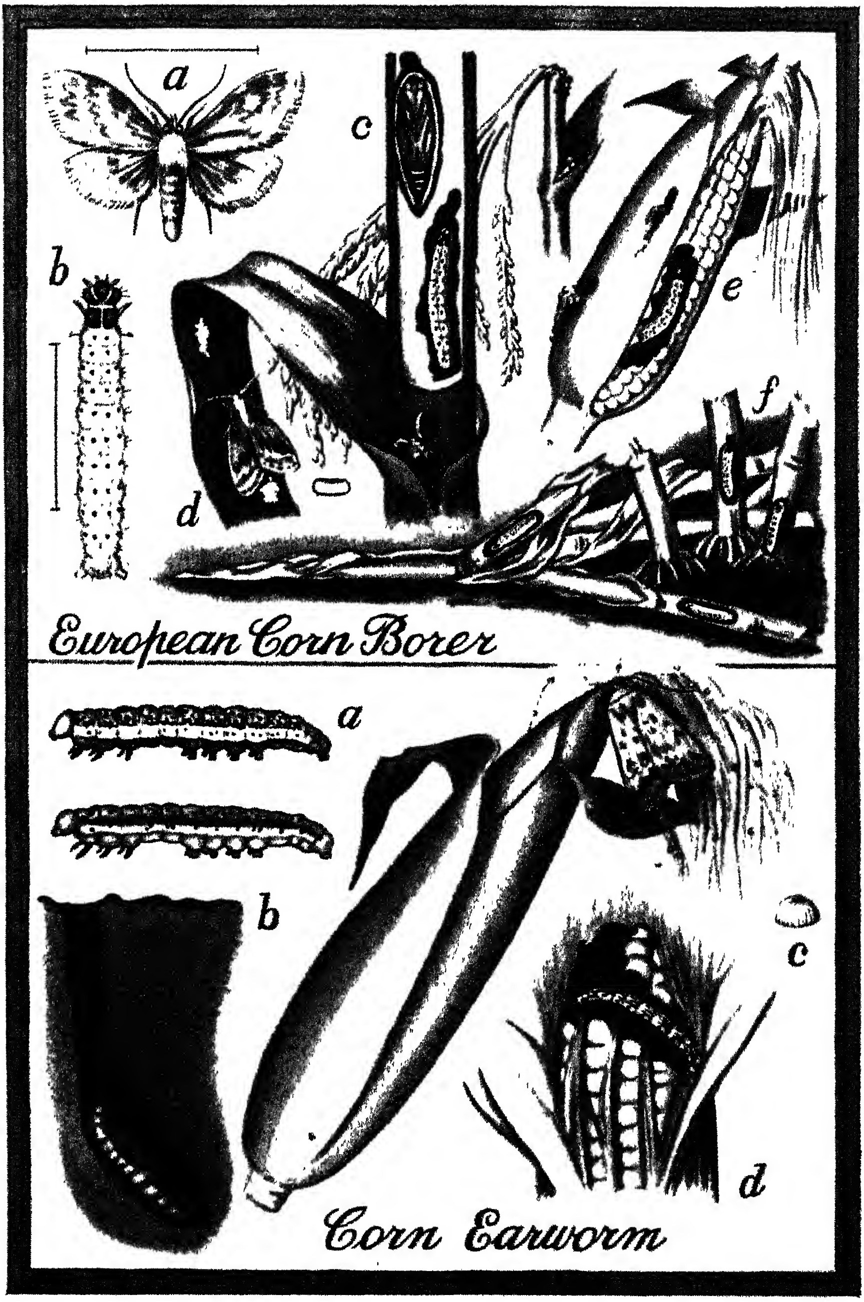


One way to kill borers—injecting nicotine paste

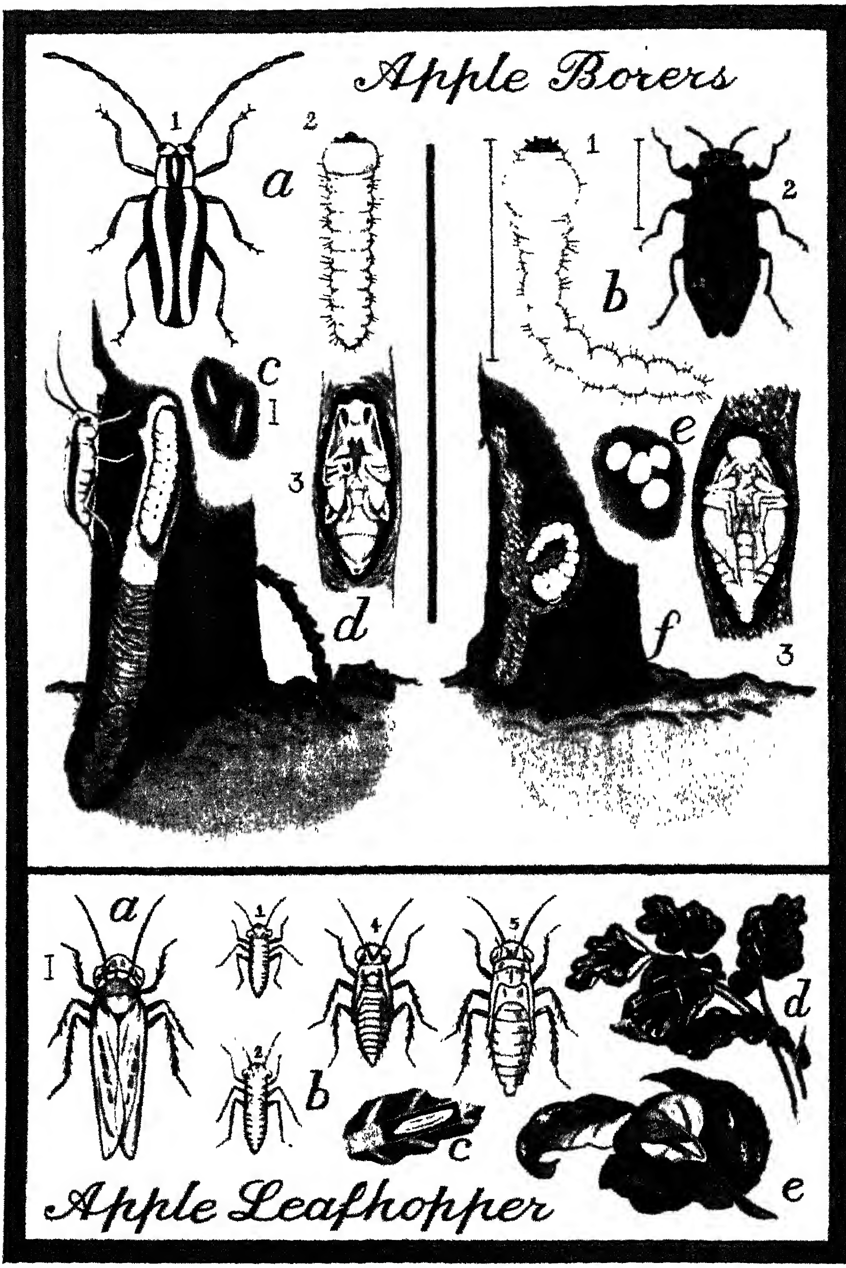
Mr. L. S. Mayne, California arborist, comments in the December 1945 *Arborist's News,* which arrived as I was writing about borers, that Dr. Bromley omitted mention of the mixture of ethylene dichloride and carbon tetrachloride as used in the West for many years to control the red turpentine bark beetle by injecting into holes with a blunt-nosed syringe and plugging the holes with putty. This is a standard treatment, mentioned frequently by Dr. Herrick in his book, *Insect Enemies of Shade Trees.*

For wrapping, many gardeners like kraft paper, which comes in 4-inch-wide bolts of 2 thicknesses, with a thin layer of asphaltum between. In wrapping, start at the top and wind spirally downward, overlapping one half the width at each spiral; tie firmly with twine wound spirally in the opposite direction. Wrap from the first branch down to the soil, and mound earth slightly around the base so that all bark is covered. Keep nursery trees wrapped for 2 years after transplanting.

Sometimes special mixtures are applied to trunks to kill borers. One recipe calls for a pound of paradichlorobenzene stirred into 2 quarts of cottonseed oil previously heated to 120° F., then cooled and used to paint the bark. Such mixtures may be quite injurious if applied in hot weather or to a large area of bark. As an amateur you'd better not experiment on your trees in that fashion. Even a proprietary mixture, such as Crystal Borer Repellent, should be used with great caution, following directions exactly.



XIII **EUROPEAN CORN BORER:** **(a)** adult moth; **(b)** larva, a smooth caterpillar; **(c)** pupa and larva inside corn stem, borer frass protruding from hole; **(d)** female moth laying eggs on corn leaf; **(e)** borer working in ear of corn, presence shown by protruding frass; **(f)** larvae overwintering in old corn stalks. **CORN EARWORM:** **(a)** larvae, brown- or green-striped caterpillars; **(b)** pupa in soil; **(c)** female moth laying eggs on corn silk and single egg (much enlarged); **(d)** full-grown worm feeding in mass of frass at tip of ear.



XIV **ROUNDHEADED APPLE TREE BORER:** **(a1)** adult beetle; **(a2)** roundheaded grub (larva); **(a3)** pupa in wood cell; **(c)** eggs; **(d)** section of tree trunk showing borer at work and frass protruding. FLATHEADED APPLE TREE BORER: **(b1)** larva with flat enlargement behind head, and characteristic curved position; **(b2)** beetle (somewhat enlarged); **(b3)** pupa in cell; **(e)** eggs; **(f)** larva in winter chamber in gallery inside tree trunk. **APPLE LEAFHOPPER** (See POTATO LEAFHOPPER): **(a)** adult; **(b1, 2, 4, 5)** nymph in different instars between molts; **(c)** egg in leaf vein; **(d)** potato leaf showing hopperburn; **(e)** apple leaves showing curling and whitening.

The use of paradichlorobenzene and ethylene-dichloride emulsion as fumigants for fruit trees is discussed under Peachtree Borer.

Ash Borer (*Podosesia fraxini*), apparently limited to ash and mountain ash, makes so many burrows in trunks that trees remain small and are easily broken over. It is found from Minnesota through the Dakotas to Montana. The adult is a moth, front wings opaque with a transparent basal streak, hind wings transparent with yellow margins, abdomen black with yellow bands. The larvae are common at the base of trees, often just below ground level. The common borer in ash in the East is the lilac borer, which see.

Azalea-stem Borer (*Oberea tripunctata myops*) is a beetle girdling stems of azalea, rhododendron, dogwood, blueberry, mountain laurel, elm, and perhaps other plants in spring. It is slender, ½ inch long, with a yellow head and thorax, 2 black spots on the latter, and grayish-yellow punctate wing covers. Twigs are girdled in 2 places, ½ inch apart, and a yellow egg thrust through the bark halfway between. The tip dies and the yellow grub bores down the twig and into the trunk, pushing out sawdust from holes near the ground. After 2 or even 3 years it pupates, producing beetles in summer.

Control. Cut off and burn wilted twigs an inch or more below girdled portion as soon as noticed. Kill grubs in burrow with fumigants discussed in introduction to Borer section.

Branch and Twig Borer (*Polycaon confertus*)—A cylindrical beetle, ½ inch long, black with brown elytra, burrowing into twig crotches or buds of apricot, olive, avocado, citrus, and fig trees, sometimes grapevines. The larvae are large, whitish, with fine hairs; they work in dead heartwood of many ornamental trees. This borer is present in California and parts of Oregon.

Prune off infested twigs on small fruit trees; burn dead brush and orchard prunings.

Broad-necked Root Borer (*Prionus laticollis*)—A brownish-black beetle with long serrated antennae, 1 to 1¾ inches long. The large, yellowish, legless grub, 2½ to 3 inches long, excavates a burrow in roots of oaks, sometimes poplar, chestnut, apple, pine, and grape. Rhododendrons growing among old roots may also be attacked, infested stems being easily broken off at about ground level. The life cycle may take 3 years.

Bronzed Birch Borer (*Agrilus anxius*)—A native beetle distributed through northern United States as far west as Colorado and Idaho. It attacks white, gray, black, and canoe birches, poplar, quaking aspen, cottonwood, and willow. It is more injurious to ornamental trees grown in the open than to forest trees. The beetle is slender, olive-bronze, with a blunt head, tapering body, nearly ½ inch long; the grub is white,

slender, with the region just back of the head enlarged, and with 2 horny, forceps-like appendages at the tip of the abdomen. It mines in irregular winding galleries just under the bark, which is loosened.

The first sign of injury is the dying back of a tree at the top, by which time it is too late for control measures. Such trees should be cut and burned before beetles emerge in late April or May to lay eggs in slits in the bark of other trees. The borer almost always infests trees weakened from other causes, so the chief preventive measure is to promote vigor with proper food and water when needed.

Brown Wood Borer (*Parandra brunnea*)—A native beetle occurring all over this country. The larva, yellow-white, flattened, with black head, bores winding galleries in beech, walnut, hickory, willow, chestnut, oak, elm, tulip, locust, ailanthus, soft maple, basswood, black ash, pine. The beetle, glossy chestnut brown, 3/4 inch long, appears in July and August on apple, pear, and cherry. This borer is apparently associated with wounds. Prune carefully, leaving no broken projecting branch stubs.

Burdock Borer (*Papaipema cataphracta*)—A moth larva infesting stalks of delphinium, dahlia, sometimes hollyhock, goldenglow, and iris. The caterpillar is smooth, pale brown with a white stripe down the back and along each side. Kill borers by inserting a wire in hole in stalk, or by squirting in a few drops of nicotine sulfate. If necessary cut and burn infested portions. Keep down weeds.

California Peachtree Borer—See **Western Peachtree Borer.**

California Prionus (*Prionus californicus*)—A very large, shiny reddish-brown beetle, 1½ to 2½ inches long, with a white grub 2 to 3 inches long. It is common along the Pacific coast and is present in Arizona, New Mexico, Colorado. The adults fly at night, midsummer to fall, are attracted to lights, and often hit windows with great force. The larvae breed normally in dead and decaying roots and stumps of live and deciduous oaks, but may work in living and dead roots of alder, almond, cherry, cottonwood, eucalyptus, madroña, orange, peach, plum, poplar, prune, English and black walnut. The fruit trees are sometimes killed.

Probing for and destroying larvae seem to be the only control.

Carpenter Worm—See under **Worms.**

Cedar Tree Borer (*Semanotus ligneus*)—Working in bark and wood of living arborvitae, also redwood, Douglas fir, and Monterey pine. It makes winding burrows in inner bark and sapwood, girdling the tree and causing death. The adult is a brown beetle, ½ inch long, with 2 blue patches at the base of the elytra and a broad yellowish band near the top.

Clematis Borer (*Alcathoe caudata*)—The larva of a clear-wing moth, working in the fleshy roots of clematis.

Cloaked Knotty Horn (*Desmocerus palliatus*)—A dark blue beetle with

a yellow "cloak" thrown over the upper portions of elytra. The borer is creamy-white, an inch long, riddling base of stems of wild and cultivated elder with burrows, causing dying back of branches. The beetles sometimes eat notches out of leaves.

Columbine Borer (*Papaipema purpurifascia*)—Larva of a moth, restricted to stem and fleshy roots of wild and cultivated columbine. The reddish-brown moth scatters its eggs over the ground near the plant, the larvae hatching in late April or early May. They enter petioles of new leaves, then bore down until they reach the roots by midsummer. The borer is salmon-colored with a pale stripe down the back, 1½ inches long, when full-grown. Sawdust-like castings on the ground and dying back of the plant indicate borers at work. Rake or scrape the soil thoroughly in spring to kill eggs.

Cottonwood Borer (*Plectrodera scalator*)—A large beetle distributed from Maryland to Louisiana, particularly injurious in the Middle West to cottonwood, poplar, and willow. It is not a pest in New England, New York, or Pennsylvania. The beetle is mottled black, 1½ inches long, with antennae longer than the body. The larva is a large grub, 1¾ to 2 inches, deeply constricted between segments. It tunnels beneath bark, and into wood at the base of trunks, infested trees blowing over easily. Sawdust and shredded wood cuttings mark its presence. It feeds as a larva for 2 years before coming out as a beetle to lay eggs at the base of trees.

A protective wash on the trunk, 1 part lime-sulfur to 10 parts whitewash; or a wire screen guard can be used. These borers can sometimes be killed with a wire, or by injecting carbon bisulfide.

Currant Borer (*Conopia tipuliformis*)—A yellowish caterpillar, larva of a small black-and-yellow clear-winged moth that looks like a wasp. It is distributed throughout North America, attacks gooseberry and red and black currants, being more destructive on the latter. The borer lives in a tunnel in wood over the winter, feeds a little, and then pupates in spring, with adults emerging in June and July to lay eggs in bark of canes.

Infested canes look yellowish in spring and die within a few weeks. Cut such canes close to the ground and burn before moths emerge.

Dendrobium Borer (*Xyleborus morigerus*)—Minute brown beetles boring into pseudobulbs and depositing eggs in broad galleries. The larvae make long galleries in feeding. Badly infested bulbs wither and die. Cut out and burn infested orchid bulbs as soon as noticed.

Dogwood Borer (*Conopia scitula*) works in the cambium of older bark of flowering dogwood and sometimes causes death of limbs. The infested area may be 2 feet or more long and contain as many as 50 borers. The larva is white with a brown head; the moth has transparent wings with blue-black margins. Pecan, ninebark, and chestnut may also be attacked.

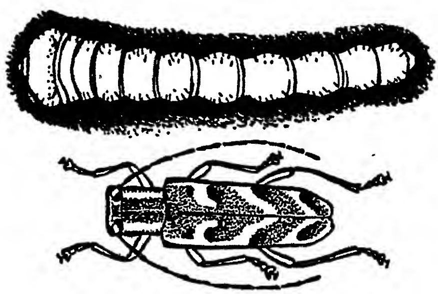
Remove outer dead bark, where borers overwinter, and keep bark smooth at base of branches.

Dogwood Cambium Borer (*Agrilus cephalicus*)—The flatheaded larva of a beetle working in soft wood; widely distributed, but only rarely injurious. Wrap newly transplanted trees; feed and water them properly.

Dogwood Twig Girdler (*Oberea tripunctata*)—Also known as elm twig girdler, a lemon-yellow grub, larva of a long-horned beetle, boring in the center of twigs. Its presence is shown by frass coming out of holes in dying twigs. Cut out and burn such twigs.

Elder Borer (*Achatodes zeae*)—The spindle worm of corn, working in the tassel or spindle, present wherever wild and cultivated golden elder grow. The larva is yellow-white with a double row of black dots across each segment and a black head. The moth has rust-red fore wings mottled with gray and yellowish-gray hind wings. Several larvae may be present on one shoot. Cut out old dead elder wood in fall to destroy eggs.

Figure 46



Elm borer—beetle and larva

Elm Borer (*Saperda tridentata*)—Roundheaded larva of a long-horned beetle, gray with red bands across the elytra. (Figure 46.) A serious pest of white and slippery elm in northeastern states. Eggs are laid in cracks in bark and grubs work into the inner bark and sapwood, cutting off much of the sap flow. Escaping sap and frass appear as moist spots on bark. The borers are reddish at first, later creamy-white, an inch long when grown, usually, though not always, attacking weakened trees.

During periods of drought watch for signs of injury and dig out any borers found. Keep trees growing vigorously with plenty of water.

European Corn Borer (*Pyrausta nubilalis*)—One of the most destructive of corn insects. (Plate XIII, page 150.) It probably came into this country in shipments of broomcorn from Italy or Hungary in 1908 or 1909, but it was not recorded until 1917, in Massachusetts. It has since spread through New England, south to North Carolina, west to Wis-

consin and Iowa. It is chiefly a stalk pest, not only in corn but dahlia, aster, chrysanthemum, gladiolus, and other herbaceous ornamentals, as well as in beans, beets, celery, potatoes. In fact, it is recorded on about 200 species of plants with stems large enough for the worms to enter.

The larvae—inch-long flesh-colored caterpillars with conspicuous black dots—winter in old stalks left around the garden and pupate there in spring. The female moth is yellow-brown with wavy dark bands; the male is somewhat darker. They have a wingspread of 1 inch, fly mostly at night. Eggs are laid in groups on underside of corn leaves over a period of 3 to 4 weeks; there is a total of 500 to 600 eggs per female. These eggs start hatching in early June, the young larvae invading the central whorl of leaves, getting into the tassels, working down into the stalks and into the bases of ears. Broken tassels, bent stalks, sawdust-like castings outside small holes—all signify borers at work.

There seem to be 2 strains of the European corn borer with two generations in the strain present in New England, New York, and New Jersey, the late brood appearing in August; but only one generation in the strain found in central states and Canada, with egg-laying from June to August.

Control. Sanitation is important—cleaning up and burning all stalks, corn or dahlia or weed, capable of harboring borers over winter. In regions where there are two generations, corn planted the latter half of May usually matures between broods. Early and late corn should be dusted with 1 per cent rotenone, or fixed nicotine dust, every 5 days, starting when the tassels are barely discernible. Direct the dust down into the whorl. A new insecticide, Ryanex, promises to be about as effective as rotenone for corn borers.

Fir Flatheaded Borer (*Melanophila drummondi*), also called **Western Hemlock Bark Borer**—Infests normal or injured trees in the West—firs and Douglas fir, hemlocks, larch, yellow pine, spruces, with the latter preferred. Adults are black or bronze beetles; larvae excavate shallow winding burrows.

Flatheaded Apple Tree Borer (*Chrysobothris femorata*)—A common pest throughout North America. (Plate XIV, page 151.) The larvae mine inner bark cambium, sapwood, and heartwood of healthy, injured, or dying deciduous fruit and shade trees, including apple, apricot, ash, mountain-ash, beech, boxelder, cherry, chestnut, cottonwood, currant, dogwood, elm, hickory, horsechestnut, linden, maple, oak, peach, pear, pecan, plum, poplar, prune, sycamore, willow, also raspberry, rose. In the West, oak is the preferred food plant; in the East, maples and sugar maples and fruits are more often attacked. This borer kills many trees and shrubs in the nursery, and many trees the first 2 or 3 years

after transplanting. Injury is worse in dry seasons and to tree trunks exposed to too much sun through excessive pruning.

The winter is passed as a grub, a slender white worm with a broad flat enlargement just behind the head, usually lying with the body curved to one side. The borer tunnels just under the bark until full size, 1 inch, and then bores deeper in the wood. The tunnels, filled with dry frass, run 6 inches or more down the trunk of a small tree or may go around the trunk to girdle it. Overlying bark is discolored, often dies.

The beetles, brownish with a metallic luster, flat, ½ inch long, emerge in May or June and hang around the sunny side of trees or logs. They lay eggs in bark cracks or some portion of the trunk injured by sunscald or bruising. There is a 1-year cycle.

Control. Preventive measures are best: wrap newly transplanted trees with paper or burlap (see introduction to this section); shade exposed trunks of young fruit trees, or paint with whitewash containing 10 per cent lime-sulfur; prune young fruit trees to keep them headed low; fertilize and water properly. Remove borers already in tree with a knife or wire, and paint the wounds.

Gall-making Maple Borer (*Xylotrechus aceris*)—A small brown beetle attacking red, silver, Norway, and sugar maples. The larvae mine in trunks of small trees and branches of larger trees so extensively that the branch beyond the wound is broken off by wind. The new wood produced to heal the wound makes a conspicuous gall.

Grape Root Borer (*Paranthrene polistiformis*)—The larva of a brown-and-orange clear-wing moth. It is found in the East and Pacific Northwest, but is not an important pest. Eggs are laid on foliage, larvae drop to ground and bore into roots, remaining there for 2 years before pupation in soil outside roots.

Cultivation to destroy pupae is a helpful control measure.

Hemlock Borer (*Melanophila fulvoguttata*), also called **Spotted Hemlock Borer** and **Eastern Flatheaded Hemlock Borer**—It ranges from Maine to North Carolina, attacks hemlocks and spruces. The beetle is flat, ½ inch long, with 3 round yellow-red spots on each wing cover. The larva is white, small, with the same type of enlargement behind the head as the apple tree borer.

The larvae separate the bark from the wood with wide, shallow galleries, often killing trees in parks and on estates as well as those in forests. The beetles emerge in May, June, and July. There is one generation a year. There are several parasites to hold this borer in check, but severely infested branches should be pruned off and burned. Be sure trees have enough water.

Iris Borer (*Macronoctua onusta*)—Probably the most destructive pest

of iris and apparently limited to this host. (Plate XV, page 166.) The borer winters in the egg stage on old iris leaves and other near-by debris. The larvae, hatching in late April or early May, crawl up the iris leaves and make pinpoint holes as they enter. They gnaw out soft leaf tissue between upper and lower surfaces and work their way slowly down toward the rhizomes, leaving a water-soaked (due to exuding drops of sap) and ragged appearance to the leaf fans. While in the leaves the larvae are slender and about an inch long, but after reaching the rhizomes, usually in early July, they become fat and repulsive smooth-skinned pinkish caterpillars 1½ or more inches long. After eating out the interior of the rhizome, leaving only a papery skin, the borer pupates in a brown pupa case loose in the soil in August. The moths are brown with black markings, and have a 2-inch wingspread. They appear in late August or September to lay eggs on old iris leaves and sometimes on other leaves near the iris. There is only one brood a year.

The chief damage from iris borers is not so much from their own chewing, voracious as that is, but because they carry around the bacteria causing that vile-smelling squashy soft rot.

Control. There are several points of attack. Fall sanitation destroys a good many borer eggs. I wait until after first frost, then descend on the iris bed with a bushel basket and pull off all old iris leaves which loosen easily, leaving only short new fans for the winter. Theoretically it is possible to spray young leaves in spring with lead arsenate, plus wheat or soybean flour or fish oil as a sticker, and so prevent young borers from entering leaves, but it is difficult to time such sprays and to keep the rapidly growing foliage protected.

If the iris planting is small, it is feasible to inspect it frequently and, whenever a leaf appears wet or ragged, to locate the borer and kill it in place, merely by pressing the leaf enclosing the worm between thumb and finger.

If iris is to be divided, do it as soon as possible after flowering, long before the borers get down to the rhizome, cutting off and burning infested portions of leaves. To kill soft-rot bacteria, disinfect rhizomes with their cutback fans in bichloride of mercury, 1 to 1,000 solution, for 30 minutes. Some gardeners are successful with other disinfectants, but I still swear by this virulent poison for an effective job. Instead of destroying the borers by burning or poison you can toss them to the thrushes and catbirds, who will probably be waiting around with open mouths as soon as you start to operate on iris.

Lesser Cornstalk Borer (*Elasmopalpus lignosellus*)—Sometimes injurious to corn in the South. Slender, greenish, brown-striped worms bore into lower part of stalk, not more than 2 inches from the soil surface,

causing distortion and curling of stalks of young corn, and often failure to produce ears. This borer feeds also on pea, bean, cowpea, peanut, turnip. It is worse on sandy soils and may be found almost anywhere, though the real injury is in southern states. When the larvae are full-grown they leave cornstalks and spin cocoons on ground under trash. The moths, brownish-yellow with gray margins and black spots, appear in 2 to 3 weeks to lay eggs on leaves or stalks. There are two generations yearly.

The only control measures are early planting, fall and winter cleanup of land, and rotating corn with some other crop.

Lesser Peach Borer (*Sanninoidea pictipes*)—Nearly as important as the peachtree borer, attacking stone fruits, peach, plum, cherry, wild plum, wild cherry, and Juneberry in all peach-growing sections except the West, and most abundant in the South. Masses of gum mixed with brown sawdust exude from upper trunk and branches, especially at forks. White caterpillars with brown heads, about 3/4 inch long, work in bark under these gum masses. They pupate in cocoons inside the burrows but close to the openings which are covered with silk webs. Metallic, blue-black, yellow-marked wasp-like moths emerge in May and June, very active on sunny days, to lay eggs in bark crevices, around crotches or wounds.

This borer is not important in well-sprayed and fertilized trees and those with wide-angle crotches. Suggested control measures are digging borers out by hand and painting trunks with a mixture of paradichlorobenzene and oil—a rather risky procedure.

Lilac Borer (*Podosesia syringae*), also known as the **Ash Borer**—Much more important than the true ash borer. It attacks lilac, and green, white, English, and mountain-ash, is distributed through the East and as far west as Colorado. Probably every gardener is familiar with old lilac trunks full of holes and protruding sawdust. On ash there are large scar-like outgrowths where the caterpillars have burrowed in the trunk. Small branches often break at the point of injury. Green ash in the Mississippi Valley and English ash in the East seem particularly subject to attack. (Plate XV, page 166.)

The white borer, 1 1/2 inches long, with a brown head, winters in the wood, usually near the ground, feeds again in spring, pushing its burrow out nearly through the bark and then pupates in the burrow. The adult, emerging in May or June, is a wasp-like clear-wing moth with brown fore wings, transparent hind wings with a dark border, wing expanse 1 1/2 inches; an active flier. The females lay eggs in masses around rough scars or knots in the trunk and branches of ash, and at the base of lilac stems.

There is apparently some confusion between 2 very closely related species. The May and June dates for moth emergence are reported for

Illinois. In New York, and also in Virginia, the moths have been observed to emerge each year in August and September.

Control. The easiest way for the home gardener to control this borer on lilac is to inject carbon bisulfide into the holes, closing them with putty, or to squeeze in some nicotine paste. Closing the opening is then unnecessary. Work on the holes showing fresh sawdust. Old lilac trunks infested with borers should be cut out and new growth encouraged. A fungus is an efficient parasite of the lilac borer.

Linden Borer (*Saperda vestita*)—Principally a linden pest, although it may attack poplars. It is common in the Northwest and parts of the Middle West, being most injurious to young trees in nurseries or to newly transplanted trees. The beetles, up to ¾ inch long, olive to yellow-brown, with 3 dark spots on each wing cover, feed on bark of growing shoots, on leaf petioles, and large veins of leaves, often killing tips of branches. Eggs are laid in incisions in trunk and branches. Larvae, white, slender, 1 inch long, mine in bark and wood.

Digging out by hand is the most feasible control.

Live Oak Root Borer (*Stenodontes melanopus*)—A very large beetle working on eastern live oak, also pecan and hackberry, from Virginia to Florida and along the Gulf coast. The adult is dark brown, flat, broad, 1¾ to 2¼ inches long, with slender antennae; the larva is white, as thick as a finger, nearly 3½ inches long, with prominent body segments. The female lays eggs in collar of young trees just below ground surface and the larvae bore into the roots of young oaks, enlarging the root into a huge gall and preventing formation of new roots. New suckers around old stumps make for scrub-oak barrens instead of stately live-oak forests.

Digging out by hand is the only control.

Locust Borer (*Cyllene robiniae*)—Common wherever black or yellow locust is grown and especially injurious to locusts grown as street trees. It is a black beetle, ½ to ¾ inch long, with bright yellow lines on thorax and wing covers and a conspicuous W-shaped marking at the base of the latter. It feeds on pollen of goldenrod and other composites in autumn. The larvae, white, cylindrical, widest just behind the head, mine in inner bark and sapwood, and later burrow into solid wood. Infested trees may be full of longitudinal burrows as much as 3 inches long. Pupation is in the burrows, the beetles emerging in August and September to feed on pollen and lay white eggs in bark scars and crevices. The eggs hatch in 5 to 8 days and the larvae bore through the corky layer of bark to fashion a small cell for the winter.

Trees in forests or shaded by undergrowth are not much bothered by locust borers, but ornamental trees grown in the open are apt to be injured up to the time they are about 6 inches in diameter.

Control. Trunks and branches of valuable young trees can be sprayed, in spring before buds burst, with a mixture of ¼ pound sodium arsenite or arsenate dissolved in 5 gallons water. Or 1 pound of paradichlorobenzene can be dissolved in 1 quart heated soluble pine-tar oil diluted with 2 quarts water and applied with a paintbrush to the trunk.

Locust Twig Borer (*Ecdytolopha insiticiana*)—Causes irregular swellings in small twigs of black locust. The adult is a small brown moth. Cut out and burn infested twigs.

Maple Callus Borer (*Conopia acerni*), or **Maple Sesian**—A clear-winged moth seriously injuring hard and soft maples in New England and west to Illinois and Nebraska. It is responsible for rough, enlarged scars and deformities on trunks and branches. The trees have difficulty healing wounds because the larvae, white, ½ inch long, with yellowish heads, work in new callus tissue, enlarging small wounds so that young trees are girdled and killed. The moths are amber, with yellow heads and bands on abdomen; 1 inch wingspread. They appear in late May to deposit eggs around old scars and other rough places.

Control. Smooth off roughened bark areas; dig out borers just under the bark in spring; paint wounds and new tissues with coal tar or white lead in linseed oil.

Maple Leaf-stalk Borer (*Nepticula sericopeza*) or **Norway Maple Seedpod Borer**—A small moth, the tiny larva of which normally works in maple keys or seeds. In seasons when Norway maples bear no seeds it bores in leaf petioles, causing a heavy June drop. It is reported in New England, New Jersey, New York, and Pennsylvania, but is not a serious pest.

Maple Petiole Borer (*Caulacampus acericaulis*) or **Maple Leaf-stem Borer**—A sawfly abundant in Connecticut and perhaps other states on sugar maple. The larvae tunnel in leaf petioles, resulting in fall of many leaves in May and June. Defoliation is seldom more than one third the total leaves, so the injury is not too bad.

Nautical Borer (*Xylotrechus nauticus*)—A fleshy, yellow-white grub boring in trunk, limbs, twigs of living and dead walnuts. The adult is a beetle, ½ inch long, with light wavy crossbands on wing covers. Cut out infested portions. Burn prunings from near-by infested trees.

Oak Sapling Borer (*Hammoderus tesselatus*)—Working in saplings up to 2 inches across, of oak and chestnut, killing some trees outright, weakening others. The larva is yellow-white, fleshy; the beetle is long-horned with yellow-brown wing covers mottled with yellow. The life cycle may last 2 or 3 years.

Oak Twig Pruner (*Hypermallus villosus*)—Found west to Michigan and south to the Gulf states, attacking oak, hickory, pecan, maple, chest-

nut, locust, hackberry, elm, walnut, sweet gum, some fruit trees, but not a major pest. The larvae burrow in the twigs and then cut them off, strewing the ground under trees with severed twigs, which should be cleaned up and burned. The beetles lay eggs in smaller twigs in spring or early summer.

Orchid Bulb Borer (*Eucactophagus weissi*)—Blackish beetles, slightly over ½ inch long, with pale yellow blotches on wing covers; feed on leaves and other plant parts. The larvae feed inside bulbs and open the way for fungus rots. Remove and destroy infested bulbs, detected by pressing between the fingers.

Pacific Flatheaded Borer (*Chrysobothris mali*)—A dark brown to reddish-copper beetle, ¼ to ½ inch long. The larva is similar to the flatheaded apple tree borer, with the same enlargement behind the head. Ceanothus is preferred host, but alder, apple, apricot, ash, mountain-ash, beech, blackberry, box elder, California coffeeberry, Catalina cherry, currant, elm, eucalyptus, gooseberry, loquat, manzanita, maple, mesquite, mountain mahogany, oak, peach, pear, plum, poplar, prune, rose, sycamore, and willow may be attacked. The larvae mine normal and injured trees, preferring sunny limbs.

Control measures are the same as suggested for the flatheaded apple tree borer.

Painted Hickory Borer (*Cyllene caryae*)—Distributed from New England to Texas, or wherever hickory is grown. It is partial to shagbark hickory and also may infest black walnut, butternut, honey locust, osage orange, and hackberry. The adult is a long-horned beetle, ½ to ¾ inch long, dark brown with yellow transverse bands and a yellow W at base of elytra. This borer is chiefly a pest of cut timber; healthy trees are seldom injured.

Peachtree Borer (*Sanninoidea exitiosa*)—A native moth, the most important enemy of peach trees and also attacking plum, wild and cultivated cherry, prune, nectarine, apricot, and some ornamental shrubs of the genus prunus. (Plate XVI, page 167.) It is found throughout the United States east of the Rockies and in Arizona, Utah, and Oregon. The California peachtree borer takes its place in that state.

First sign of injury is usually a mass of gum and brown frass at the base of the trunk, indicating that the white, brown-headed worms are at work in the bark, anywhere from 2 to 3 inches below ground to 10 inches above. They winter as larvae of all sizes in the burrows, finish feeding in spring, attain full 1-inch length, then pupate in silk cocoons in soil near the base of the tree. Shortly before moth emergence (midsummer in the North) brown pupa cases are forced partly out of the cocoons. The female moth is blue-black with clear hind wings and an orange crossband

on the abdomen; the male has mostly clear wings and narrow yellow bands on the abdomen. Each female lays several hundred eggs near the base of the tree trunk, the young worms hatching in 10 days to bore inside the bark. Peaches seldom survive repeated borer attacks.

Control. The standard remedy is a ring of paradichlorobenzene crystals placed around the tree trunk in fall after all eggs are hatched but while the temperature is above 55° F. This means late September in the vicinity of New York City or about the middle of October in Georgia. Loosen the soil around the tree, apply the crystals in a ring 1 inch away from the bark, then mound with 2 or 3 shovelfuls of earth to hold in the fumes. (Figure 47.) The dosage, which must be exact, varies with the age of the tree: ½ ounce for 3-year trees, ¾ ounce up to 6-year size, 1 to 1½ ounces for older trees.

Figure 47

Peachtree borer controlled with a ring of paradichlorobenzene crystals around the trunk, mounded over with earth

Peach Twig Borer (*Anarsia lineatella*)—A small, reddish-brown larva, under ½ inch long, boring in and killing tips of twigs, infesting fruit later in the season. This borer, a minor pest in the East and South but quite injurious in California and Colorado, infests plums, prunes, nectarines, almonds, apricots, as well as peaches. The grayish moth is so small it is seldom noticed.

Spray with lead arsenate plus a spreader after petal fall and when first wilted shoots appear.

Ethylene-dichloride emulsion is replacing paradichlorobenzene to some extent. It is effective in colder weather but may injure trees unless the emulsion is carefully made and used at correct dilution. Available as a proprietary mixture, it can be made at home (though I don't advise it) by stirring 9 parts ethylene dichloride into 1 part fish-oil soap, then slowly adding, while stirring, 8 parts of water. This stock emulsion is diluted according to tree age: ¼ to ½ pint of 3 parts stock mixed with

7 parts water for 2- or 3-year-old trees; ½ pint of 2 parts stock to 3 parts water for 4- or 5-year-old trees. Recently propylene dichloride has shown promise as a substitute for ethylene dichloride. It can be used at half the strength and seems more effective, reaching borers at unusual depths.

DDT may be a future means of control. In one experiment where peach foliage was sprayed with DDT for oriental fruit moth there seemed to be enough residual DDT on trunk to control the borers.

Pear Borer (*Conopia pyri*), also called the **Apple Crotch Borer**—It infests apple more often than pear and also may bore in hawthorn, mountain-ash, and shadbush, from Maine to Texas. The adult is a black, clear-winged moth with orange markings. The borers are found in crotches and in rough bark of neglected trees.

Pecan Borer (*Conopia scitula*)—The Dogwood Borer, which see. It attacks pecan in North Carolina, Georgia, Florida, Mississippi, being worse on recently top-worked trees. Protect scions from borer injury by covering all graft wounds with grafting wax which will not crack.

Pecan Carpenter Worm (*Cossula magnifica*), also known as the **Oak** or **Hickory Cossid**—It bores into trunk and larger branches of pecan, oak, and hickory. Reddish pellets of wood at base of the tree indicate that the pinkish larva, 1½ inches long with short fine hairs, is boring within. The moth is gray, mottled with brown and black.

Pigeon Tremex (*Tremex columba*), or **Pigeon Horntail**—A native wasp-like insect distributed over the United States in 3 different forms with *columba* the northeastern species, *aureus* in Colorado, New Mexico, Arizona, and California, and *sericeus* in southeastern states. The cylindrical white larvae, which are wrinkled with a short horn on the end of the body, bore tunnels in diseased and dying trees, most commonly elm and sugar maple, but sometimes beech, apple, pear, sycamore, oak, and various conifers. The female moth has a reddish head and thorax, black abdomen with yellow bands, bluish wings, and an ovipositor extending an inch beyond the body.

Control. Squirt carbon bisulfide into burrows. The ichneumon wasp is a helpful parasite. The female lays her eggs right through wood into the burrow of the horntail grub.

Poplar Borer (*Saperda calcarata*)—A large native beetle, distributed throughout the country, attacking Lombardy and other poplars, cottonwood, aspen, and willows. It severely injures ornamental shade trees, marring them with blackened swollen scars on outside of wood honeycombed with irregular galleries. The beetle is bluish-gray with black dots and yellow patches and 3 yellow stripes on elytra; 1⅛ inches long. Adults, appearing from July to September, make slits in the bark for eggs. The

larvae work in bark and sapwood the first year and in interior of wood the second year, but they always send out frass to the opening in the bark and it accumulates at the base of the trees.

Trees too seriously infested should be cut and burned in May, before adults emerge. Borers can be cut or probed out of other trees or, better, fumigated in their burrows with carbon bisulfide or the ethylene-carbon tetrachloride mixture. Creosote painted on egg scars in autumn will kill young grubs.

Poplar and Willow Borer (*Sternochetus lapathi*), also called **Mottled Willow Borer**—A small European snout beetle which has spread from Maine to Wisconsin and North Dakota since it was first noted in New York in 1882. It attacks willow, poplar, alder, and birch. The grubs, thick, legless, about ½ inch long, work in the cambium where they form burrows around the trunk and girdle the tree, but as they mature they enter hardwood and honeycomb it with galleries. Smaller limbs and branches have swollen knotty areas; foliage may wilt. The beetles, ⅓ inch long, are covered with black and white scales in a mottled effect.

Burn seriously infested trees. Painting the trunk with a mixture made by emulsifying 1 quart of carbolineum with 1 pound sodium carbonate dissolved in 1 quart hot water and diluted with 2 quarts of water has been recommended but is risky for the amateur.

Potato Stalk Borer (*Trichobaris trinotata*)—Injures potatoes, early varieties in particular, and may attack eggplant and weeds. It occurs almost everywhere except states farthest north. It hibernates as an adult, a blackish snout beetle, ⅕ inch long, frosted with gray hairs. It eats deep holes in stems of new plants in spring and lays eggs in similar cavities in stem or leaf petioles. The very small, yellow-white wrinkled grubs hollow out the stems for several inches, causing wilting and death of plants. Before pupating, each larva packs its burrow with "excelsior" from its own frass and chews an exit passage for the adult.

Collect and burn all potato vines right after harvest. Destroy weeds.

Raspberry Cane Borer (*Oberea bimaculata*)—A long-horned beetle generally distributed from Kansas eastward, a pest of raspberry and blackberry, sometimes rose. The slender black female beetle, with 2 or 3 black spots on a yellow thorax, makes a double row of punctures around the stem near the tip and lays an egg between the girdles. The tip wilts and the grub on hatching in summer bores down the cane an inch or two before hibernating, then the next season continues to bore down inside the cane to the ground, killing the cane, and pupates inside the burrow, completing the cycle.

Cut out and burn wilted tips as soon as noticed, pruning 6 inches below the punctured area. Cut and burn wilted or dead fruiting canes.

Raspberry Root Borer (*Bembecia marginata*)—Tunnels in main roots and crowns of blackberry and raspberry. The adult is a clear-wing moth, with black body crossed by 4 yellow bands. Eggs are laid in late summer on foliage, small larvae hibernating the first winter in blister-like elevations of bark just beneath soil level or under flakes of bark at base of stems, making extensive galleries in spring. By the second summer the whole crown may be hollowed out. Pupation is in burrows with moths emerging in midsummer at the end of a 2-year cycle.

Destroy wild plants around the berry patch; dig out borers, or remove and burn too seriously infested plants. Try putting a pound of tobacco dust around each plant, mounding firmly with soil, after October first.

Red-necked Cane Borer (*Agrilus ruficollis*)—Causes swellings on raspberry, blackberry, and dewberry canes in eastern states. Canes may die or break off at the swollen point. Dull, bluish-black beetles, 1/3 inch long, lay eggs in bark of canes, usually near a leaf. The young larvae burrow upward in sapwood and several times around the canes, girdling them.

The only remedy seems to be cutting out and burning swollen canes. Some varieties are reasonably resistant to attack.

Rhododendron Borer (*Conopia rhododendri*)—A small, native clear-wing moth injuring rhododendrons and sometimes adjacent mountain laurel and azalea in eastern United States. The moths, which have black and yellow abdomens, a purplish border to the transparent wings, lay eggs in June on twigs or larger branches. The yellow-white larva, about 1/2 inch long, forms an irregular gallery in the sapwood, remains dormant over winter, and in spring tunnels outward almost to the bark (so the moth can easily break through), before pupating in a thin cocoon. Injury in the same shrub increases from year to year, small plants and branches being girdled and dying, leaves wilting and browning, main stems filled with holes protruding fine sawdust.

Cut off and burn dead or dying parts in winter and spring. Nicotine paste in holes showing fresh sawdust may help.

Rose Stem Girdler (*Agrilus communis rubicola*)—Primarily a rose pest but sometimes found in raspberry. Small greenish beetles lay eggs under bark, preferably of *Rosa rugosa* or *R. hugonis*. The grubs make 1 or 2 spiral mines around the canes which swell at such points and sometimes split. Cut off infested canes before beetles emerge in spring.

Roundheaded Apple Tree Borer (*Saperda candida*)—A native beetle distributed generally east of the Rocky Mountains. (Plate XIV, page 151.) It is best known as an apple pest but may be injurious to quince, pear, mountain-ash, hawthorn, wild crab, shadbush, and chokecherry. It usually works in tree trunks at ground level, or just above or below, killing young trees, seriously injuring older specimens. The life cycle is

completed normally in 3 years in the North, 2 in the South. The young grub, first brownish-red, later creamy-white, starts work in the bark, producing brown sap stains, then tunnels in the sapwood for a year or two, ejecting conspicuous coils or piles of rusty brown frass. The next season it bores into the heartwood, tunneling outward in fall to prepare a winter chamber near the bark. The upper end of this chamber, curved out so it almost touches the bark, is filled with sawdust-like frass; the lower end is packed with coarse wood cuttings. The larva pupates here in spring, emerging toward summer.

The beetle, just under an inch long, is yellow or reddish-brown above, white underneath, with 2 conspicuous white stripes the length of the body and prominent gray antennae. The adults crawl over the tree, feeding somewhat on foliage, and lay eggs anywhere from 8 to 20 inches above ground to 1 to 2 inches below.

Control. Examine trees carefully, scooping away an inch or two of earth at the base, for brown castings or stained areas in bark. Cut out young borers in shallow tunnels with tip of a knife blade; probe for deep-seated borers with a flexible wire; or fumigate borers inside by injecting carbon bisulfide from a machine-oil can and closing the opening with putty, or injecting nicotine paste. If a regular apple-spray program is carried on, some of the beetles will be killed as they feed on the leaves.

Shot-hole Borer (*Scolytus rugulosus*), equally well known as the **Fruit Tree Bark Beetle** (Figure 48.)—This is a European insect which arrived here prior to 1877 and is now found across the country. It makes small

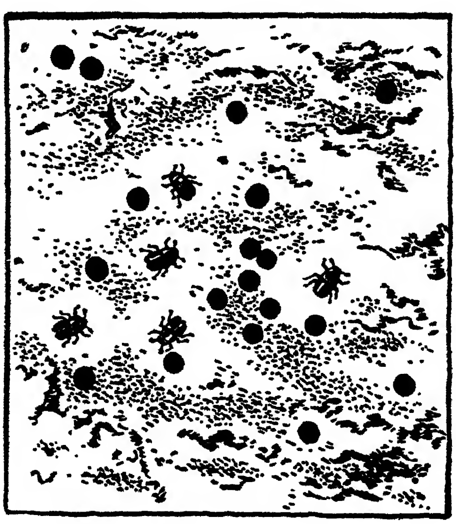
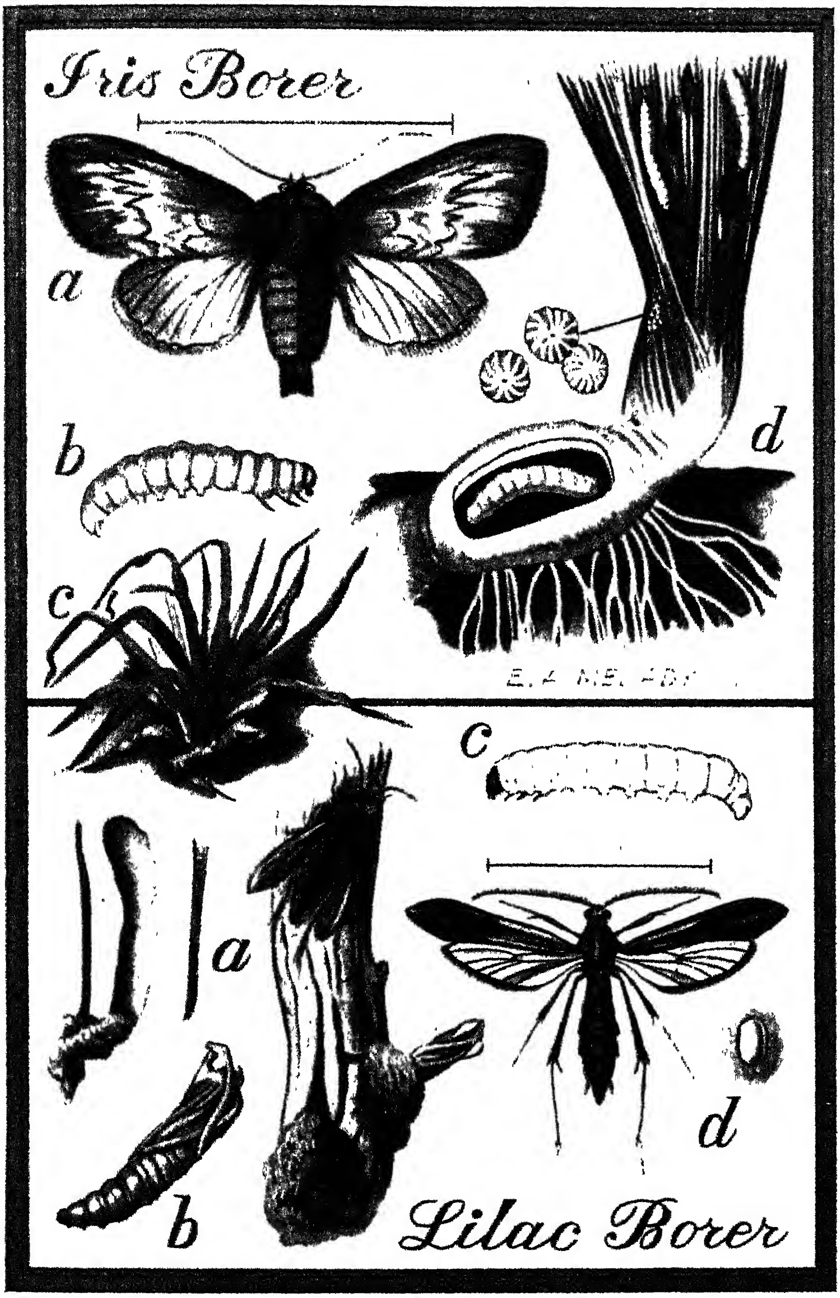
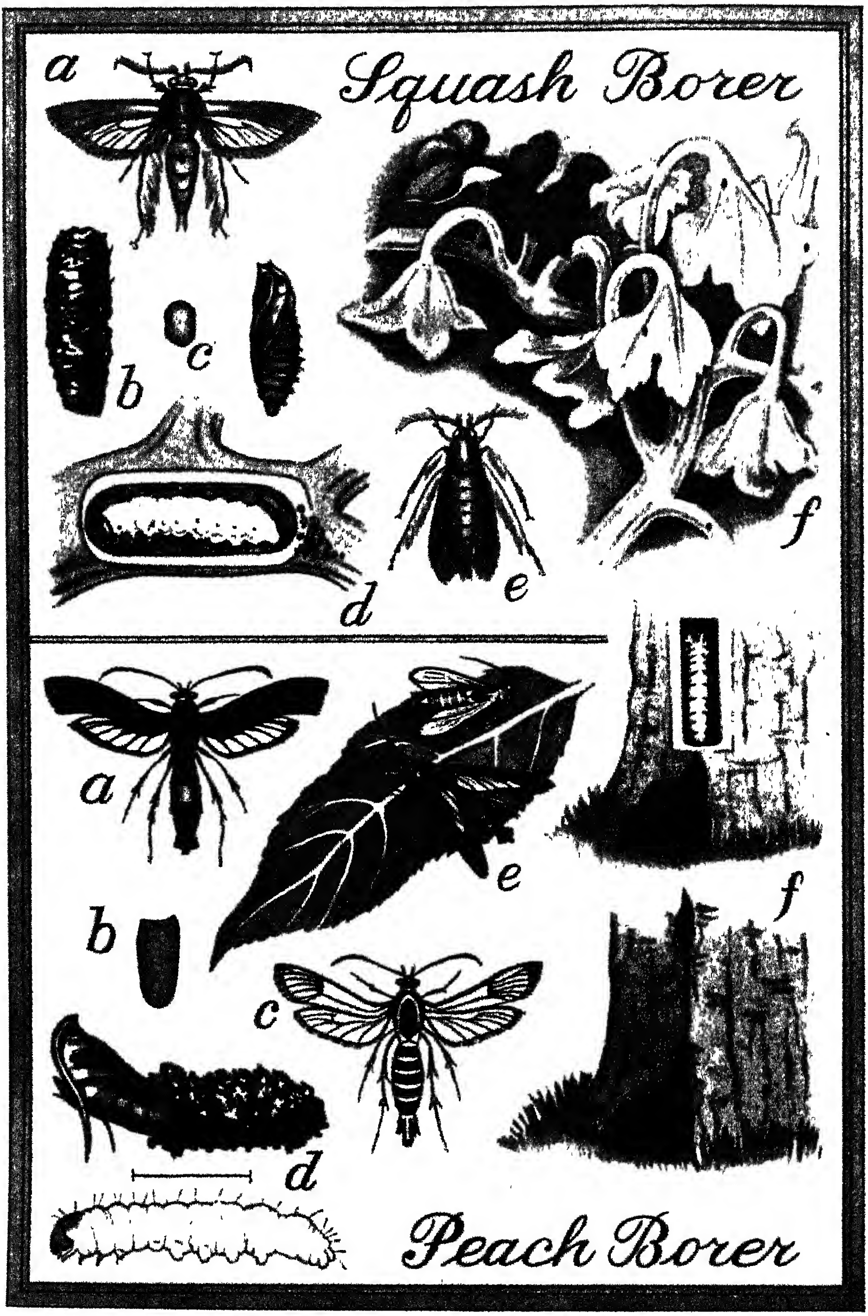


Figure 48

Shot-hole borer: bark section showing emergence holes, small beetles



XV **IRIS BORER:** **(a)** moth, somewhat enlarged; **(b)** borer, not quite full-grown; **(c)** infested iris; **(d)** young borers shown for size on outside of leaves (usual position is inside fold of leaf), older borer in hollow rhizome, and eggs (enlarged). **LILAC BORER:** **(a)** lilac stems showing tunnel and protruding sawdust, moth, and pupa case; **(b)** pupa; **(c)** borer (larva); **(d)** adult moth and egg (enlarged).



XVI **SQUASH BORER:** **(a)** female moth; **(b)** cocoon; **(c)** egg (enlarged) and pupa; **(d)** borer in stem; **(e)** male moth; **(f)** vine wilting from borer injury. **PEACH-TREE BORER:** **(a)** female moth; **(b)** egg (enlarged); **(c)** male moth; **(d)** pupa protruding from cocoon, and borer; **(e)** adults on peach leaf; **(f)** section cut in trunk to show borer in position, jellylike frass at base.

holes, like shot holes, in the bark of healthy twigs of fruit trees and in branches and trunks of weakened trees, attacking almond, apple, apricot, loquat, mountain-ash, cherry, elm, hawthorn, Juneberry, nectarine, peach, pear, plum, prune, and quince. On stone fruits the shot holes are usually covered with gum; if beetles are abundant, the foliage yellows, wilts, the tree may die.

The pinkish-white grub, 1/8 inch long, winters in the inner bark. The galleries are winding, sawdust-filled, leading out from a shorter central gallery. The black, blunt beetles, 1/10 inch long, emerge in early summer, and the females fly to unhealthy trees to excavate an egg gallery in branch or twig, depositing eggs on each side of this in typical bark beetle fashion. There may be from one to three generations, the latter in the South.

Control. Painting trees with carbolineum or other materials usually results in injury. If trees are sickly, feed heavily in spring with a nitrogenous fertilizer, nitrate of soda, or sulphate of ammonia (4 to 5 pounds per tree), and keep well watered. During winter cut out and burn seriously infested wood.

Sinuate Pear Tree Borer (*Agrilus sinuatus*)—A European beetle first noticed in New Jersey in 1894. It is primarily a pear pest, but may injure hawthorn, mountain-ash, cotoneaster in the East, being reported in New England, New York, New Jersey, and Ohio. The beetles are slender, very flat, 1/3 inch long, purplish-bronze. They feed on foliage and lay eggs in bark cracks. The grubs are long, slender, flat, and make sinuate galleries in trunk and branches.

Clean up dead or dying trees or branches during winter; spray pear foliage with lead arsenate when beetles emerge (May or June), and repeat 2 weeks later.

Southern Cornstalk Borer (*Diatraea crambidoides*)—A southern insect, found from Kansas south, principally on corn. Infested stalks are twisted and stunted, often with an enlargement near the ground. Leaves are ragged, showing holes eaten out while still in the whorl. Borers are dirty gray-white, with many dark brown spots, an inch long, usually found near ground. They pupate in stalks and straw-colored moths emerge in midspring, to lay many overlapping eggs on underside of leaves. The worms may move from one plant to another and there are one to three generations.

Control by sanitation, rotating corn with some other crop, and by late fall or winter plowing or spading.

Southwestern Corn Borer (*Diatraea grandiosella*)—A corn pest from Kansas through the Southwest. Insect and injury resemble southern cornstalk borer, which see.

Squash Borer (*Melittia satyriniformis*)—A native pest, present east of the Rocky Mountains, probably our most destructive squash pest, often spoiling 25 per cent of the crop and injuring pumpkin, gourd, cucumber, and muskmelon in the order named. The borer winters as a larva, or as a pupa inside a silk-lined dark cocoon, an inch or two below soil level. (Plate XVI, page 167.) The adult is a wasp-like moth, with copper-green fore wings and orange-and-black abdomen, appearing in June in middle Atlantic states. It lays 150 to 200 eggs, singly, on the stem, especially at base of the main stem, and on leaf stalks, blossoms. Young borers hatch in about a week, tunnel into the stem to feed, first sign of their presence being sudden wilting of the vine and masses of greenish-yellow excrement protruding from holes in the stem. The borer, a wrinkled caterpillar about 1 inch long, can be seen by slitting the stem with a knife.

In the North there is one generation, the borers making cocoons in soil a month to 6 weeks after hatching. In the South the second generation appears in August and September. Around New York City there is often a partial second brood.

Control. If a change in location is possible do not grow squashes two years in succession on the same ground. If the same area must be used, spade or plow it in fall to expose cocoons. Pull up and burn vines immediately after harvest. Spray or dust with rotenone or nicotine, starting when the vines are young and being sure to cover base of stems. If a vine starts to wilt, kill the borer with a knife and heap earth over the stem joints to start new roots. Make a second planting of summer squash to mature after the first borer brood has disappeared.

Stalk Borer (*Papaipema nebris*)—A universal feeder, occurring everywhere east of the Rocky Mountains. This borer, a brown caterpillar with white stripes down the body, 3/4 to 2 inches long, works in the stem of any plant large enough and soft enough for its operations. It prefers giant ragweed and corn, is a frequent pest of dahlias, is often found in hollyhock, aster, lily, rhubarb, pepper, potato, and tomato, to name but a few.

The stalk borer hibernates as grayish-ridged eggs on grasses and weeds, which hatch very early in spring. The young borers work first in grasses before going over to herbaceous stalks, which they enter at the side and then burrow up. They are always on the move, changing one host for another, and finally pupate in late summer just under the soil surface or, rarely, in stalks. The grayish-brown moths, with white spots on fore wings and a spread of 1 inch, appear in August and September, to lay upward of 2,000 eggs per female. There is only one generation a year.

Control. By the time injury is noted it is usually too late to save the plant, but frequent inspection may locate holes and protruding sawdust

in time to inject nicotine paste or carbon bisulfide, or to kill the borer in place with knife or wire. Clean up the garden in fall, getting rid of weeds and crop refuse.

Strawberry Crown Borer (*Tyloderma fragariae*)—The chief strawberry pest in Kentucky and Tennessee and ranging into Illinois, Missouri, and Arkansas. The adult is a small brown snout beetle, less than 1/5 inch long, shaped like a grape seed, with each wing cover marked by 3 black bars. The grub is small and yellow, taking on a pinkish tinge when it starts to feed on strawberry tissues. The strawberry borer winters as an adult under trash in beds, feeds on foliage, and lays eggs in leaf bases. The grubs tunnel in the crown, killing or stunting plants.

Control lies in setting only certified plants, destroying old beds promptly after last picking, setting new beds in soil that has been in cultivation for at least a year and 1,000 feet away from an infested bed (this rule hardly applicable to the home garden), and the use of apple pomace-fluosilicate bait, such as Go-West.

Sugar-maple Borer (*Glycobius speciosus*)—A native, apparently confined to this host and a dangerous enemy in northeastern states. The adult is a striking long-horned beetle, black with yellow markings and tips of wing covers; 1 inch long. The larva is 2 inches long, somewhat flattened, rose-white; it burrows a wide channel several feet long in inner bark and sapwood, often going halfway around the tree. The bark over this section cracks, producing an ugly scar, to which other injurious insects are attracted. There is a 2-year cycle, beetles laying eggs in summer.

Remove all dead branches before June first, cut out grubs with a sharp chisel where possible, or kill borer with a bent wire, painting over wounds with coal tar. Or inject carbon bisulfide into burrows.

Tiger Hickory Borer (*Goes tigrinus*)—A long-horned beetle widely distributed in eastern and central United States. It attacks hickory, mines in wood of oak, preferring white oak and walnut. The adult is a brown beetle with a dark band, covered with fine gray hairs, and pinkish antennae. The larva is lemon-yellow, with prominent segments an inch long. It excavates large burrows in sapwood and inner bark. The life cycle may last 3 years.

Twig Girdler (*Oncideres cingulatus*)—A beetle with the habit of cutting off branches of trees and then depositing eggs in cut-off portions; working on hickories, pecan, elm, oak, persimmon, pear, and others. The adult is grayish-brown with a light gray area in middle of each wing cover. The male has antennae much longer than the body and golden hairs on front of head. In young trees injury may be considerable, especially in pecans, where the twig pruning deforms the tree and lessens the crop of nuts.

Pick up and burn severed branches.

Twig Pruner—See **Oak Twig Pruner.**

Two-lined Chestnut Borer (*Agrilus bilineatus*)—A native beetle attacking not only weakened but normal trees, distributed from Maine to Texas, attacking black oak and chestnut, also bur, scarlet, red and white oaks. The beetle is slender, 3/8 inch long, greenish-black, covered with golden hairs and with a golden stripe down each wing cover; it may feed on foliage. The larva is slender, white, flat, with an enlargement just behind the head. Grubs mine in cambium, girdling trunk and branches and working from 40 to 50 feet in the air down to the ground. Weakened trees die rapidly.

Control by removing dead trees before beetles emerge in May, spraying foliage with lead arsenate, or spraying trunk and branches with dormant lime-sulfur solution.

Western Flatheaded Borer—See **Pacific Flatheaded Borer.**

Western Peach Borer (*Sanninoidea opalescens*)—Similar to peachtree borer but injuring all common stone fruits—peach, plum, prune, apricot, and sometimes apple and almond. Control with paradichlorobenzene as recommended for the eastern form.

BUDMOTHS

Budmoths are moths whose larvae are budworms: small caterpillars which feed on opening buds. Two apple pests and a pecan insect have budmoth as their common name, while species infesting spruce, tobacco, and other buds go under the name of budworms.

Eye-spotted Budmoth (*Spilonota ocellana*)—A fruit pest distributed through northern apple-growing sections, attacking apple, pear, cherry, wild plum haw. This budmoth apparently came here from Europe more than a hundred years ago. The larvae, small brown worms with black heads, winter in small silken cases attached to twigs or bud axils, and in spring eat out buds as they open, or tie leaves together with silken threads. In early summer they pupate in these silken nests, producing small brown moths, with a light band on each wing cover, to lay eggs for the summer generation. The second brood mines the leaves to some extent and may injure fruit.

Control. Spray with lead arsenate when buds are opening and again at cluster bud and calyx periods.

Lesser Budmoth (*Recurvaria nanella*)—Similar in appearance and habit to eye-spotted budmoth, but may mine leaves to some extent.

Pecan Budmoth (*Gretchena bolliana*)—Primarily a bud feeder, some-

times causing excessive branching or stunting of pecans. Young larvae are black; older caterpillars yellow-green with brown heads, just over ½ inch long. Eggs are laid on foliage or, early in season, on twigs.

Control. Spray with calcium arsenate in spring and summer.

False Budworm—See **Corn Earworm.**

Spruce Budworm (*Archips fumiferana*)—A serious enemy of forest trees and ornamentals, distributed over northern United States from the Atlantic to the Pacific. It ranks third in economic insects, next to the cotton boll weevil and the corn earworm. It has cycles of enormous abundance in spruce and balsam forests, and may attack ornamental plantings of spruce, balsam, white and Douglas fir, pine, larch, hemlock. An injured forest looks as if it had been swept by fire, and trees that do recover have 1 to 5 feet of terminals killed.

Dark reddish-brown caterpillars, with a yellow stripe along the side, feed on opening buds and needles, tying them together with silk. As partly grown larvae they overwinter in silken cases on branches, starting activity when buds break in spring. They pass through 5 instars, growing larger with each molt, migrating from older buds to younger and more succulent food, including tender foliage. Sometimes they spin downward on silk, like cankerworms, and drift with the wind to other trees. They pupate in a cocoon of silk and leaf remnants for 3 to 4 weeks, with moths emerging in late June and early July. The latter are dull gray, marked with bands, streaks, and spots of brown, with ¾ inch wingspread. They lay green, flat, overlapping eggs on the needles, the young larvae feeding for a while before hibernating in their silken cases.

Control. Spray ornamentals with lead arsenate when young larvae appear in midsummer. Several hymenopterous parasites help keep the spruce budworm in bounds.

Tobacco Budworm (*Heliothis virescens*)—Distributed from Connecticut southward; most injurious in the Gulf states. Tiny rust to green caterpillars eat holes in buds or unfolded leaves, not only of tobacco and cotton but also geranium, ageratum, groundcherry, and other solanaceous plants. Moths have light green wings with 4 oblique light bands, a wingspread of 1½ inches. Eggs are laid singly on underside of leaves. Pupation is in the soil and there are two generations a year.

Control. Make a bait mixture of 1 part lead arsenate or cryolite mixed with 75 parts corn meal and place small pinches around the plants. Repeat as needed. A very efficient braconid parasite is found in many worms.

Verbena Budworm (*Olethreutes hebesana*)—A pest of verbena and physostegia. The larva is greenish-yellow with a black head, less than ½ inch long; the adult is a small purplish-brown moth. The only recommended control is clipping off and burning wilted new shoots.

TRUE BUGS

To the layman almost any insect is a bug. To an entomologist the word "bug" means a member of the insect order Hemiptera—meaning half-winged—so named because the upper half of the front pair of wings is thickened and quite stiff while the lower half is thin and membranous. Wings of true bugs are folded flat over the back when at rest, instead of being held in a roof-like position like those of leafhoppers. In bugs the hind wings are usually shorter and wider than the fore wings.

Bugs have a gradual metamorphosis, the nymphs like adults except for size and possession of wings (See Figure 14, page 65, Chapter IV), but there are some wingless forms and sometimes the adults have short wings. Antennae of bugs have 5 or fewer segments, the mouth parts are piercing-sucking, and control is normally by means of contact insecticides. Many bugs, however, are quite resistant to the usual contact poisons, and for these Sabadilla and DDT both offer hope for the future.

The water bugs—water boatmen, backswimmers, water scorpions, water striders, and giant water bugs—are of little interest to gardeners. Bedbugs are household pests. The other bug groups, those afflicting plants, are treated below in alphabetical order.

Alder Lacebug (*Corythucha pergandei*)—Infesting alder, elm, crabapple, sweet birch, and hazel. The body is black but pale above with a brown band. See Lacebugs.

AMBUSH BUGS (family Phymatidae)—One member of this family commonly hides in flowers and captures bees and other insect visitors. It is yellowish-green, about ½ inch long, marked with a black band across the abdomen, and has front legs adapted for capturing prey.

Apple Lacebug (*Corythucha coelata*)—Recorded on apple in California. It has a black body, whitish wings. See Lacebugs.

Apple Redbug (*Lygidea mendax*), sometimes called **False Apple Redbug,** and **Dark Apple Redbug** (*Heterocordylus malinus*)—Distributed east of the Mississippi River and most destructive in New York and New England, attacking apple, pear, hawthorn. The apple redbug is orange-red, the dark redbug reddish-black; both are about ¼ inch long. Leaves are curled, covered with numerous small, dark, slightly sunken spots, each one where the insect beak has punctured the surface to get sap, and the fruit has a pitted or dimpled appearance, somewhat woody in texture, often russeted. (Figure 49.) The bugs winter as eggs on bark, hatch early in spring, and the nymphs start feeding as the leaves unfold, later going on to young apples. There is only one generation a year.

Control. Add nicotine sulfate to lead arsenate in the regular pink and calyx sprays, or use nicotine sulfate and fish-oil soap as a separate spray.

An oil-emulsion dormant spray as used for scales kills many overwintering eggs.

ASSASSIN BUGS (family Reduviidae)—A large family of predaceous bugs which feed on insects with some members attacking man and other large animals. One of these, the "kissing bug," preys on bedbugs but also bites man. Assassin bugs are helpful to the gardener because many of them feed chiefly on aphids, leafhoppers, and caterpillars, although sometimes they also feed on beneficial ladybeetles.

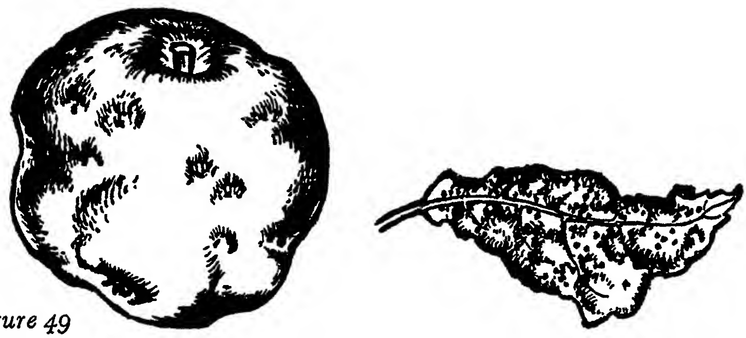


Figure 49

Redbug injury to apple fruit and foliage

Azalea Lacebug (*Stephanitis pyriodes*)—A major pest of azaleas wherever they are grown. (Figure 50.) Both nymphs and adults cause trouble by sucking sap from undersides of leaves, resulting in a gray, splotched, blanched, or stippled appearance of upper surface. The underside of leaves is discolored by black and brown varnish-like excrement and cast skins. Lacebug injury is most unsightly and reduces plant vitality.

The small adult, 1/8 inch long, has lacy wings with brown and black markings, light brown legs and antennae. The nymphs are nearly colorless at first, later black and spiny. Elongate eggs laid in leaf tissues along the veins hatch in 20 to 25 days, the life cycle being completed in 35 to 45 days. There are two or more generations.

In Alabama overwintered eggs start hatching in February, building up a dense population during March, April, and May and often another infestation in July, August, and September. In New Jersey eggs start hatching in late May or early June but serious damage is a week or two later than that caused by rhododendron lacebugs. The second brood, which builds up a dense population in August and September or later, seems to be the worst one in New Jersey, with azaleas of the *amoena* or *hinodegiri* type looking entirely coffee-colored instead of having normally green foliage.

Control. In the South spray with a white oil emulsion, using 3 level

tablespoons Florida Volck (or 4½ tablespoons Nursery Volck) plus 2 tablespoons powdered derris and 1 teaspoon Black Leaf 40 per gallon of water. Apply in spring, just after blooming, then the last of May, and for a third time the last of September. In the North the usual spray is Black Leaf 40 and soap, or Wilson's O.K. Plant Spray, or any contact spray based on nicotine, pyrethrum, or rotenone, applied when nymphs are first noticed in June and later in the summer as necessary, which may mean 2 or 3, or 3 or 4, treatments after midsummer.

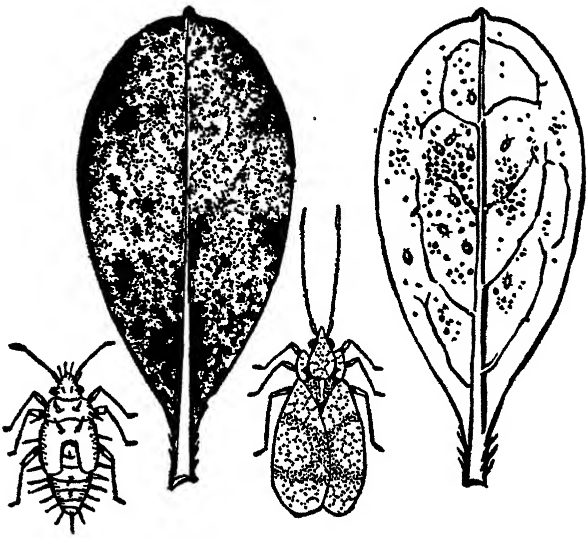


Figure 50

Azalea lacebug, showing loss of color from upper leaf surface, excrement and nymphs on lower surface; nymph and adult enlarged

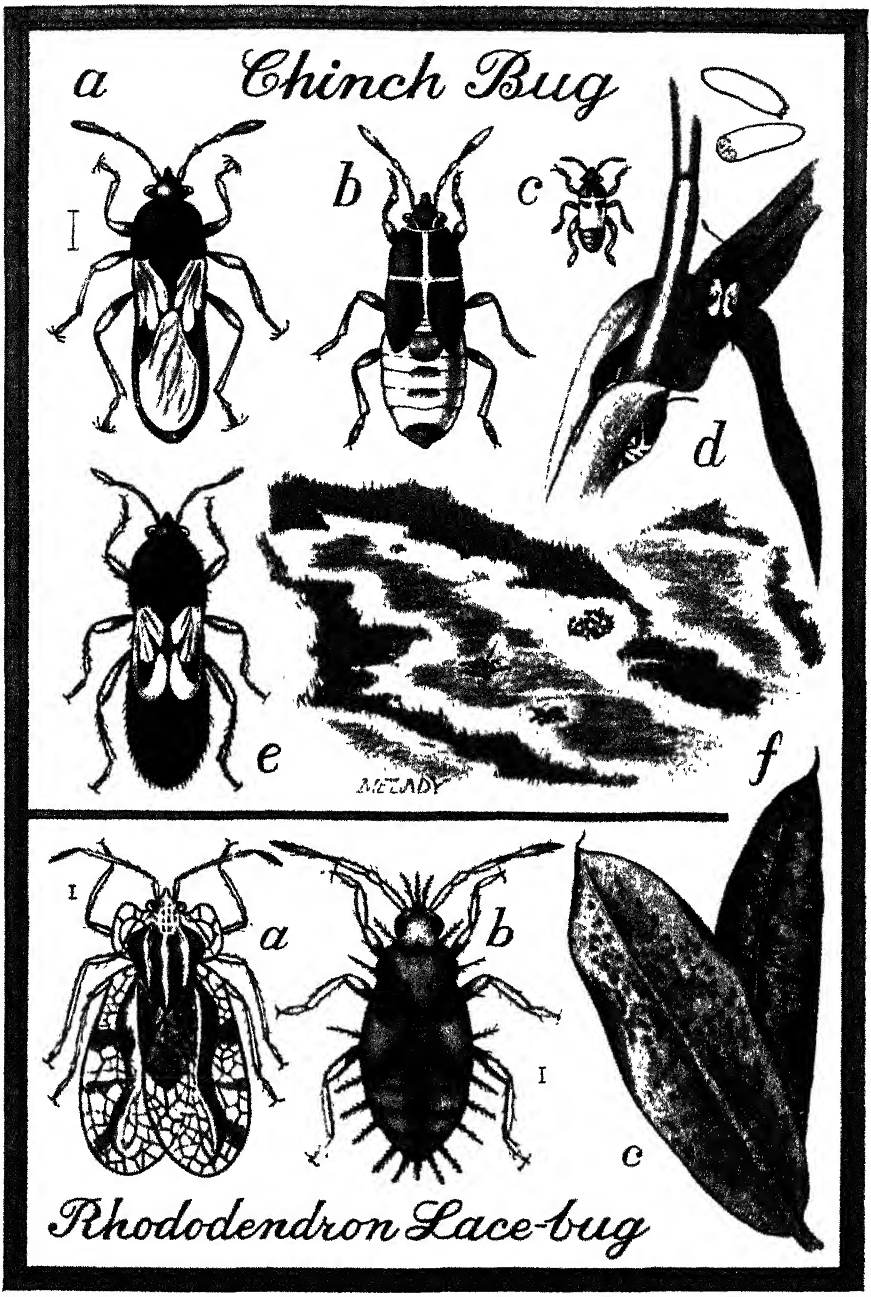
Big Convict Bug (*Corecoris confluentis*)—A common pest of eggplant and tomatoes in southern Florida. The bug is brownish-yellow, with abdomen crossed by wide stripes an inch long, ½ inch wide. It inflicts feeding punctures on fruit, which turns yellow and drops.

Big-footed Plant Bug (*Acanthocephala femorata*)—A potato pest in the South. This is the largest plant bug in Florida, more than an inch long, brown, with club-shaped leg joints, common on early potatoes where it withdraws sap for several inches from the top of the shoot, causing wilting, sometimes death.

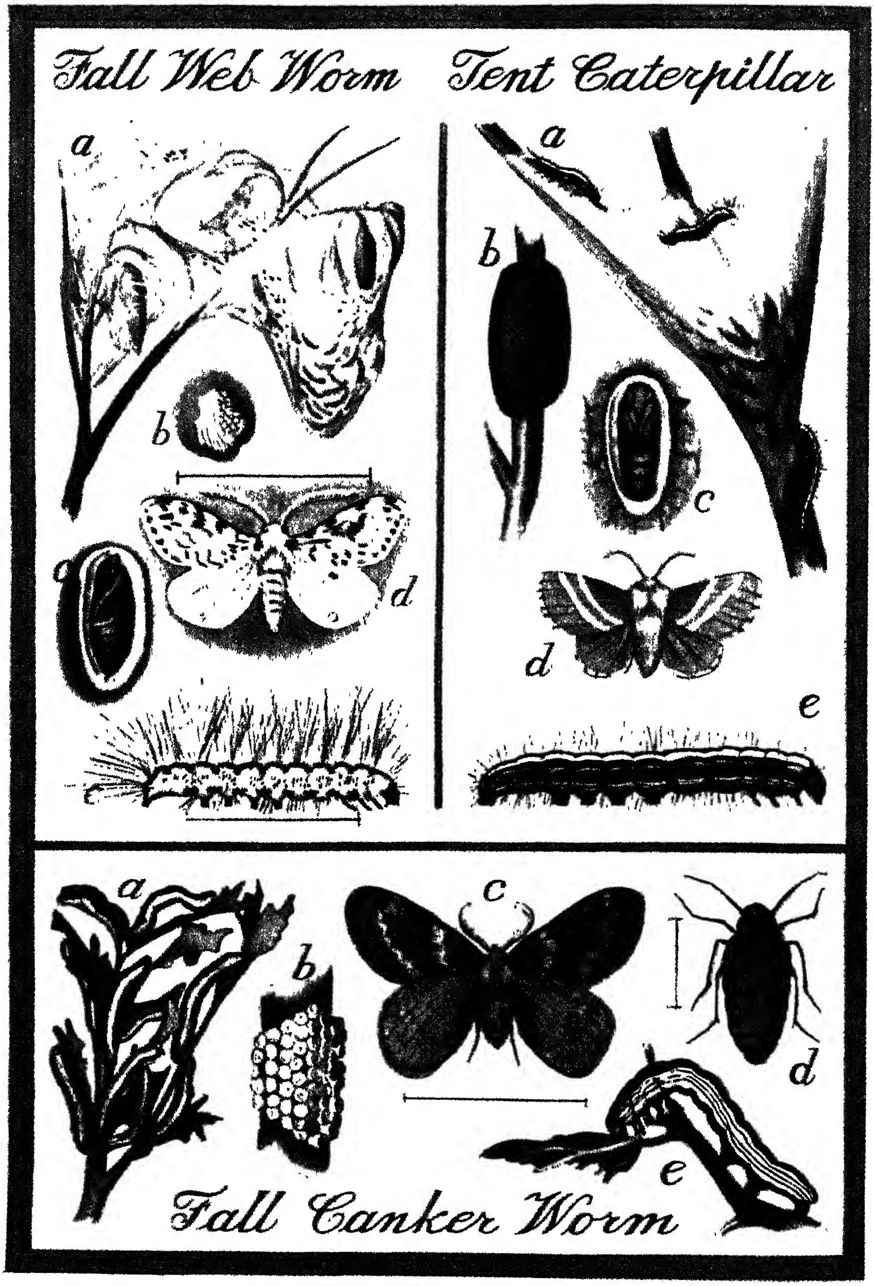
Control by hand-picking and by eliminating thistles—a weed host. Sunflowers are sometimes planted as a trap crop.

Billbugs—See **Corn Billbug** under Beetles.

Blueberry Spittle Bug (*Clastoptera proteus*)—Causes frothy masses on twigs of blueberry and huckleberry. See Spittle Bugs.



XVII **CHINCH BUG:** **(a)** long-winged adult; **(b)** nymph, fifth instar; **(c)** nymph, first instar. Hairy Chinch Bug: **(d)** eggs, much enlarged, and bugs in typical position behind boot of lower grass blade; **(e)** short-winged adult; **(f)** turf with brown areas killed by bugs and yellow margins where bugs are working. **RHODODENDRON LACEBUG:** **(a)** adult; **(b)** nymph in last stage of development; **(c)** rhododendron leaves showing browning of lower surface and loss of color on upper surface.



XVIII **FALL WEBWORM:** **(a)** web or nest over end of branches; **(b)** egg mass covered with hairs on underside of leaf; **(c)** pupa in cocoon in soil; **(d)** adult moth; **(e)** full-grown hairy caterpillar. **EASTERN TENT CATERPILLAR:** **(a)** nest full of caterpillars in tree crotch; **(b)** egg mass or collar around twig; **(c)** pupa inside cocoon attached to bark; **(d)** adult moth; **(e)** full-grown caterpillar. **FALL CANKERWORM:** **(a)** larvae ravaging foliage; **(b)** egg mass on twig; **(c)** adult male moth; **(d)** wingless female moth; **(e)** full-grown caterpillar showing 3 prolegs.

Boxelder Bug (*Leptocoris trivittatus*)—A western insect distributed from the Mississippi River to the Pacific coast, but also reported occasionally from Illinois, Wisconsin, New York, Pennsylvania, Delaware, Maryland, Indiana, and Michigan. The young nymphs are bright red; the adults, flat, narrowly oval in shape, ½ inch long, are brownish-black with 3 red stripes on thorax and red veins on the wings. (Figure 51.) There are two generations a year in most sections.

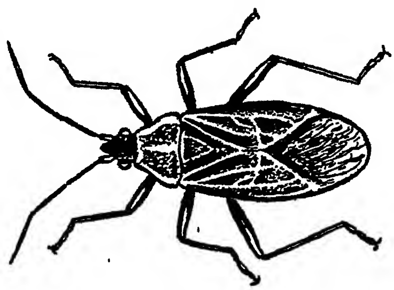


Figure 51

Boxelder bug

Nymphs and adults feed normally on foliage, flowers, and fruit of boxelder and maple, but they also may puncture and deform young fruit, such as apple, cherry, grape, peach, or plum. They swarm into houses in the fall for winter hibernation, are harmless to people, furniture, and clothing, but may feed on house plants.

Control. Spray bugs in houses with household fly sprays, those swarming on exterior of buildings with kerosene. Spray outdoor plants with pyrethrum, derris, thiocyanate or nicotine sprays at about double the strength ordinarily used for sucking insects. Only those bugs actually hit with the spray will be killed. If boxelder bugs become too much of a nuisance remove all pistillate boxelder trees on the property, taking away the bugs' favorite food.

Brown Stinkbug (*Euschistus variolarias*), also called **Spined Stinkbug**—This bug is good-sized but only half as large as the pumpkin bug or southern green stinkbug, which see. It feeds on eggplant, tomato, and other plants.

Catkin Bug (*Ischnorhynchus resedae*)—Occasionally present on catkin branches of gray birch. Aphid-like brownish or black bugs are reported as conspicuous but not very harmful.

California Christmasberry Lacebug (*Corythucha incurvata*) or **Tingid**—Limited to California and Arizona. A most disfiguring pest of the lovely red-berried photinia or toyon. The nymphs are dirty brown, with spines; the adults are yellowish-brown. Eggs are inserted in underside of leaves and covered with a brown, sticky, cone-shaped mass. Nymphs and

adults secrete quantities of honeydew, a medium for black sooty mold. There are several broods a year with adults hibernating under bark and leaves.

Control by spraying underside of leaves thoroughly with nicotine sulfate and soap or other contact insecticide.

Ceanothus Lacebug (*Corythucha obliqua*), or **Tingid**—Common on ceanothus in California, Oregon, and Idaho. The body is black, wings are pale marked with brown.

CHINCH BUGS (family Lygaeidae)—All members of the chinch bug family feed on plants or plant seeds, sucking out juices. The 2 species most important to farmers and gardeners afflict members of the grass family, which includes corn and small grains.

Chinch Bug (*Blissus leucopterus*)—Distributed throughout the United States but especially injurious in Mississippi, Ohio, and Missouri River valleys. This small insect has caused enormous damage to corn and grain crops for more than 150 years, the loss in 1 year in 1 state running up to forty million dollars. The chinch bug hibernates as an adult in hedgerows, stubble, or clumps of prairie grasses. It is a very small bug, 1/6 inch long, with white wings with a triangular black patch in the middle of outer margins, reddish legs, and giving off a distinctive vile odor when crushed.

The bugs stay in hibernation until the days warm up to 70° F., then they crawl up the grass stems and fly to fields of small grains, feed by sucking sap, and mate repeatedly, laying yellow eggs behind the "boot" of lower leaves of wheat, rye, oats, or barley, or, if the ground is loose, on the roots. The eggs hatch into minute, active, brick-red bugs with a white band across the back. They darken as they grow older, acquiring wings and the black and white color at the last molt. The cycle takes 30 to 40 days, but since they cannot feed on grain after it is cut they migrate to corn while still wingless. There they complete their cycle and lay eggs for the second generation on corn or grass. The first-generation adults die by mid-September, and those of the second live over winter. In parts of the Southwest there may even be a third generation. Another form, the hairy chinch bug (see below), has short wings and is a more common pest on lawn grasses.

Control. The crawling migration from one crop to another has made a barrier line the most feasible method of control. A narrow line of crude creosote is poured along the brow of a ridge thrown up by a plow around the margin of a field of small grain, or else strips of paper soaked in creosote are used. Recent experiments show that 5 to 10 per cent DDT powder used in a 3-inch-wide strip at the rate of 1 pound per rod is an effective barrier. Sabadilla powder also offers new possibilities. Other

experimental work on sorghum indicates that sodium nitrate as a fertilizer decreases resistance to chinch-bug attack while superphosphate increases resistance.

Cotton Stainer (*Dysdercus suturellus*)—A southern cotton insect also injurious to citrus and eggplant. It is so named because it stains the lint red or yellow when it punctures the seeds in cotton bolls. The bugs are narrow, long-legged, with a bright red thorax and brown wings crossed with yellow. This species is present in Florida, Georgia, South Carolina, and Alabama. A similar species, black and yellow, occurs in Arizona and California. The cotton stainer punctures eggplant fruit, causing a hard brown spotting and often deformation, also attacks young stems; and it stings oranges, causing considerable dropping.

Control nymphs with strong contact insecticides. Hand-pick adults, or trap them in cottonseed meal and kill with kerosene.

Crane-fly Bug (*Leptocoris tipuloides*)—Common on grass and eggplant in Florida. This is a light brown bug whose slender body and long legs suggest a crane-fly. It can be killed with strong nicotine-soap solution.

Curlew Bug, another name for billbug. See **Corn Billbug** under Beetles.

Daisy Plant Bug (*Orthocephalus mutabilus*)—Punctures leaves and flower buds of Shasta and ox-eye daisies. The effect is similar to that of the Four-lined Plant Bug, which see.

Damsel Bugs (family Nabidae)—These are small brown or black soft-bodied insects which frequent low-growing plants, often hidden in grasses or in flowers or vegetables where they capture and eat aphids, leafhoppers, and other soft-bodied insects, and sometimes butterfly eggs and larvae. One species is important as a predator on potato psyllids and sugar beet leafhoppers.

Daw Bug—See **June Beetle** under Beetles.

Doodle Bug—See **Ant Lion.**

Elm Lacebug (*Corythucha ulmi*)—An eastern pest, sometimes abundant in New York and Connecticut, reported from Ohio. Adults winter in leaves on ground, go to new foliage in spring, which turns yellow and sometimes brown and dies. Undersides of leaves are speckled with black bits of excrement.

False Chinch Bug (*Nysius ericae*)—A grassland insect sometimes injurious to truck and fruit crops in warm irrigated regions. The nymphs are pale gray with a reddish abdomen, the adults are gray or brownish. Cultivate invaded areas; spray with nicotine sulfate and soap.

FLOWER BUGS (family Anthocoridae)—This family contains important predators which are a help to us in getting rid of thrips and mites. One species is supposed to be the most important enemy of the corn earworm.

Four-lined Plant Bug (*Poecilocapsus lineatus*)—A general plant pest east of the Rocky Mountains. Supposed to be a currant and gooseberry insect but much more important to the gardener on ornamentals, where its sucking causes round, depressed, discolored spots on foliage of acanthopanax (5-leaf aralia), aconite, chrysanthemum, coreopsis, dahlia, delphinium, forsythia, gaillardia, globe thistle, heliopsis, honeysuckle, lavender, lupine, morning glory, peony, poppy, rose, Shasta daisy, sun-

Figure 52

Four-lined plant bug, and injury to chrysanthemum and mint

flower, weigela, zinnia, and other flowers and shrubs. The injury (Figure 52) varies somewhat with the food plant, aconite usually showing dark spots and chrysanthemum many light tan round areas often running together and the whole young shoot wilting. The four-lined plant bug is also one of the few insect enemies of mint, and it usually blackens up the young leaves considerably.

Hibernation is in the form of slender white eggs inserted in slits in canes of currant and other plants. They hatch in May into small bright red nymphs with black dots on the thorax, but when they change into winged adults in June they are greenish-yellow with 4 black stripes down the wings. There is only one generation a year, with feeding lasting for about 6 weeks. In most years around New York City these plant bugs stop injuring flowers the week Japanese beetles first emerge, but in some seasons the 2 afflictions overlap for a short period.

Control. The best defense against the saucy nymphs, which seem to watch you coming along, is a cloud of derris dust containing 1 per cent rotenone. The dust seems to get more bugs before they can move out of reach than a liquid spray, but either nicotine-sulfate or pyrethrum-soap solutions will kill bugs actually hit with the spray. Kerosene emulsion was once recommended but I swear by the rotenone dust. It is safe for the

plants and kills the insects if used repeatedly, keeping new growth covered.

Gold Bug—See **Golden Tortoise Beetle.**

Goldenrod Lacebug (*Corythucha marmorata*)—Common in the East on goldenrod, aster, chrysanthemum, and related plants, and often found in greenhouses. It is occasionally present in California, Arizona, and New Mexico. The body is black, antennae and legs yellow, wings whitish with brown spots and lines.

Green Bug—See under **Aphids.**

Green Stinkbug (*Acrosternum hilaris*), sometimes called **Green Soldier Bug**—A large bug ⅝ inch long, flattened, oval, bright green, lined with yellow or orange, and bad-smelling. It is a general feeder but considered a special pest of beans, where it causes pods to fall and distorts seeds, and of peach and nectarine, where feeding punctures cause fruit scars and exudation of juice. It is also listed on apple, boxelder, cabbage, catalpa, corn, okra, dogwood, eggplant, elderberry, linden, maple, mustard, orange, pea, cherry tomato, turnip.

Practice clean culture in orchards. Spray vegetables liberally with a rotenone or pyrethrum and soap mixture.

Hairy Chinch Bug (*Blissus hirtus*)—This is the short-winged form of chinch bug which has been a lawn pest in the South for many years and more recently a very serious threat to eastern lawns, causing brown patches similar to fungus brown patch or Japanese beetle injury but often much more extensive. With chinch bug injury the roots are not destroyed and the grass cannot be rolled up like a carpet, but the browned areas are most disheartening in a fine lawn.

The eastern lawn chinch bug spends the winter as an adult in tall grass, weeds, and hedges, migrating to the lawn in April or May to lay eggs at the grass roots. When the soil temperature is high enough, usually in June, the bright red nymphs start sucking at the base of grass blades. They darken and grow a little larger as they change into later instars, going through a brownish shade with a white dot or band before turning into black adults with short white wings. The females lay eggs for a second and more disastrous brood which appears in August with nymphs and adults continuing to feed into October. In November adults either settle down in the lawn or, more often, migrate to tall grasses for winter.

Injury is most serious in hot, dry weather and in lawn areas exposed to the sun. Chinch bugs show a preference for bent grasses but are not limited to them. Grass blades are punctured close to the roots and are often stained reddish. The brown circular areas are usually surrounded by yellowish sickly areas where the bugs have just started feeding. (Plate

XVII, page 174.) Unless you get nearly flat on the ground, part the grass blades, and gaze intently at one area for a few seconds it is difficult to see and identify chinch bugs. They are probably responsible for much lawn trouble ascribed to other causes.

Control. Until the wartime scarcity of rotenone, the standard treatment was 1 per cent rotenone dust applied to infested lawns at the rate of 25 pounds per 1,000 square feet, or a lesser amount if a special machine, invented particularly for use against chinch bugs, was available so the dust could be blown directly into grass roots. During the War tobacco dust, used at the same rate, had to be substituted for rotenone but was not very satisfactory. Some people reported results with a strong nicotine-and-soap spray applied generously until the grass was thoroughly wetted.

By the time this book is in print you can probably choose between sabadilla and DDT for chinch-bug control. Both have been highly satisfactory in preliminary tests against lawn chinch bugs. Sabadilla is now the chief ingredient in one of the trade-marked preparations which formerly had rotenone as the active ingredient, and DDT will probably be available to you as a 3 or 5 per cent dust, which can be applied directly or mixed with sand and the lawn treated as for grub-proofing with lead arsenate.

Whatever material is chosen, the first treatment should be made in June, when high temperatures start the nymphs into action, and the second in August for the second brood. It helps to keep grass growing vigorously by proper liming, fertilizing, and cutting, and to keep down weeds and tall grass in areas adjacent to the lawn.

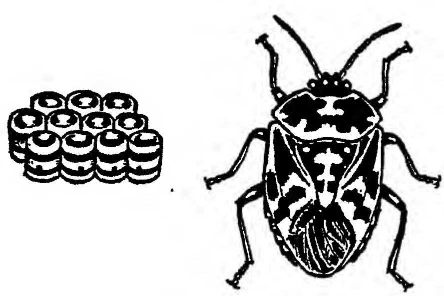


Figure 53

Harlequin bug and eggs

Harlequin Bug (*Murgantia histrionica*), also known as **Fire Bug** and **Calico Back**—The most important cabbage pest in the southern half of the United States. This bug sucks so much plant sap that cabbages wilt, turn brown, and die; sometimes whole crops are lost. Crucifers—cabbage, cauliflower, collards, cress, mustard, Brussels sprouts, turnip, kohl-rabi,

radish, horseradish—are favored food plants, but the bugs may wander over to asparagus, bean, beet, citrus trees, cherry, chrysanthemum, corn, eggplant, grape, lettuce, locust, loquat, okra, plum, potato, rose, squash, and sunflower.

The harlequin bug (Figure 53) is black with bright red markings, flat, 3/8 inch long. It winters around old cabbage stalks and other garden rubbish and lays its distinctive eggs on underside of leaves of early garden plants. They look like tiny white barrels with black hoops standing on end in a double row. They hatch in 4 days to a week, depending on the weather, and the young nymphs start destroying plants. After 5 instars and 4 to 9 weeks they mate and lay eggs for the next generation. There may be two or three generations, sometimes a partial fourth, in a season.

Control. Clean culture, trap crops to be destroyed with kerosene when infested with bugs, hand-picking in spring, and use of strong rotenone or other contact sprays have all been recommended. The new sabadilla powder now promises to be effective in controlling the hard-to-kill harlequin bug.

Hawthorn Lacebug (*Corythucha cydoniae*)—Found on English hawthorn and other thorns, cotoneaster, pyracantha, Japanese quince. I find this small, dark lacebug, with spiny nymphs, very common on English hawthorn in New Jersey and more prevalent in midsummer and later, but in the mid-South it seems to be more serious on pyracantha with the first brood at work by April and a late brood still going strong in October. The upper surface of leaves loses color in a speckled fashion while undersurfaces are colored with dark bits of excrement and conical masses over eggs. Hibernation is in adult form.

This lacebug can be controlled with nicotine-and-soap sprays applied forcibly to underside of leaves, but it takes more than one application.

LACEBUGS (family Tingidae)—The name of this family means "ornamented." The members are beautiful small flat bugs, oval or rectangular in shape with transparent wings reticulated or netted in a lace-like effect and the head covered with a sort of hood. The nymphs are darker than the adults and ordinarily covered with spines. Both nymphs and adults are plant-feeders, sucking sap from underside of leaves which they cover with large quantities of brown, varnish-like excrement.

LEAF BUGS (family Miridae)—The members of this family are small oval bugs commonly called leaf bugs or plant bugs, with the four-lined plant bug a conspicuous example. Although they have the reputation of existing on plant juices, some species are predaceous and eat aphids, especially woolly aphids and phylloxera with a waxy coating; other species feed on mites, or on eggs and young nymphs of stink bugs.

Leaf-footed Bug (*Leptoglossus phyllopus*)—Present in the East, more

particularly the Southeast, and as far west as Arizona. (Figure 54.) This is a dark brown bug with a yellow band across the body and hind legs resembling small leaves. It attacks many truck and garden crops, with potatoes, beans, cowpeas, and tomatoes great favorites. It also attacks sunflower, and may swarm on citrus fruits—first satsuma orange, next tangerine, with fewest bugs on ordinary oranges. It breeds extensively on thistle.

There is no easy control. Hand-picking and a strong soap spray on a cloudy dav or late afternoon are helpful.

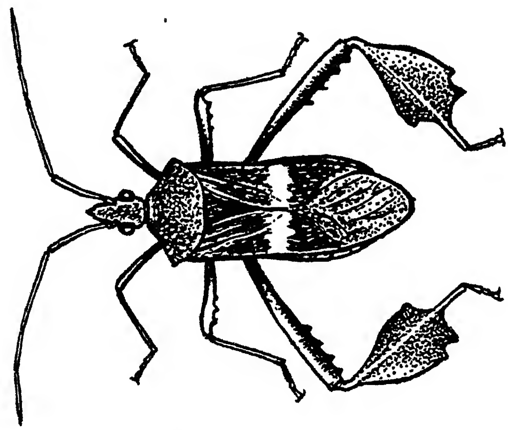


Figure 54

Leaf-footed bug

Legume Bug—See **Tarnished Plant Bug.**

Lined Spittle Bug (*Philaenus lineatus*) also known as **Froghopper**—This common insect occurs on various grasses, especially in damp situations. It winters as an egg laid between leaf and main stem and hatches in April or May in the North. The dull-colored adult starts laying eggs in midsummer and continues until autumn, there being one generation a year. See also Pine Spittle Bug.

Negro Bug (*Allocoris pulicaria*)—Present throughout the United States east of the Rocky Mountains. The bugs are very small, only 1/10 inch long, oval, black, with black or red nymphs. They congregate in large numbers, sporadically, on celery, corn, wheat, grasses, lobelia, cardinal flower, other ornamental flowers, and some fruits, imparting a bad taste to raspberries and blackberries. They winter as adults on weeds, which should be destroyed. Spraying with nicotine sulfate kills all bugs wet with the spray.

Oak Lacebug (*Corythucha arcuata*)—Rather common on oaks and sometimes so numerous that leaves are completely whitened by nymphs

sucking out cell contents. Undersides of leaves are darkened with sticky masses covering eggs. There are two generations a year. See Lacebugs.

Orchid Plant Bug (*Tenthecoris bicolor*)—Causes irregular white spots on underside of orchid leaves. The bug has an orange to red body with black and steel-blue wings. Use a contact spray safe for orchids.

Pameras (*Orthaea* spp.)—Often destructive to strawberries in Florida. They are related to chinch bugs, very small, looking like yellow ants when young, later black with yellow markings, about 1/5 inch long. They appear in strawberry beds toward the end of the season, causing young berries to become hard buttons and the plants to wither.

Destroy the weed host, wild spurge, and force a nicotine spray down into crowns of plants.

Pear Plant Bug (*Lygus communis*), called **False Tarnished Plant Bug** from its similarity to the real one. The pear bug is smaller and darker, except at tips of wings. It winters on bark and nymphs hatch in early spring, injuring young fruits by feeding punctures, causing drop or deformities. Strong nicotine sprays directed at the nymphs should give control.

PENTOMIDS—See **Stink Bugs.**

Phlox Plant Bug (*Lopidea davisi*)—A pest of perennial phlox. It is a reddish-orange bug, 1/4 inch long, feeding on upper surface of leaves, causing white spots; stunts developing buds so that flowers do not mature properly. Overwintering eggs are laid in fall, usually behind leaf petioles.

Spraying with nicotine sulfate or dusting with rotenone or other contact insecticides may help.

Pine Spittle Bug (*Aphrophora parallela*)—Widely distributed from Maine to Arkansas. Scotch pine is apparently the favorite host but white, pitch, red, Jack, Virginia pines, and Norway spruce may also show the frothy masses which look like spit. Eggs are laid in autumn, hatch in May, and each nymph settles down near the terminal to secrete about itself a white froth.

Most textbooks say that the spittle bug nymph beats air into its secretion by flipping its posterior up and down like an eggbeater, but Edwin Way Teale has made a remarkable series of photographs and observations to show just what does take place. About 5 minutes after the spittle bug nymph starts sucking plant sap a clear liquid starts to appear at its tail. This liquid is sap mixed with waxy body chemicals so that it is a kind of natural soap. At the same time air is drawn in between a pair of plates under the abdomen and forced out under pressure, like a bellows, to make uniform bubbles out of the liquid secretion. The tail going regularly up and down operates the bellows and keeps the bubbles coming.

As soon as the first bubbles are formed the nymph reaches back with

its legs and hooks onto the globules, dragging them forward to its head. Later it distributes the bubbles with its tail and is soon hidden under a mound of snow-white foam, protecting the greenish nymph from sun and preying insects. (Figure 55.)

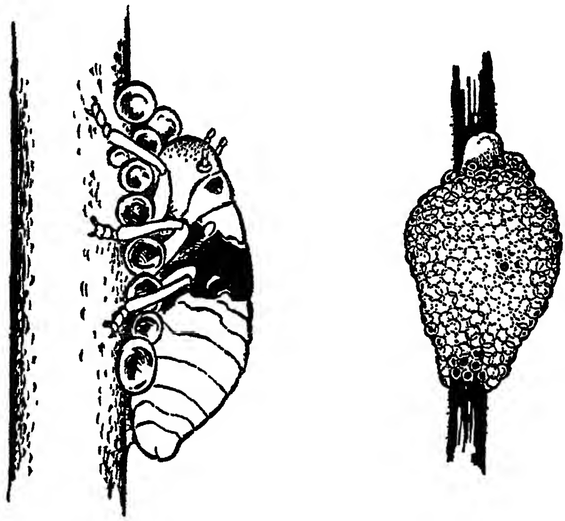


Figure 55

Young spittle bug, producing first bubbles, much enlarged (drawn from photograph by Teale), and frothy mass on pine needle

After the last molt the nymph crawls out of the protecting froth, migrates to the tip of pine needles and there transforms into a dull, brown-winged adult, much like a leafhopper. Thereafter it flies about the garden like other insects. Adult feeding punctures may cause swellings on the twigs and sometimes death of smaller branches. Very occasionally trees die.

Pyrethrum and soap sprays are effective in control.

Pitted Lygaeid (*Geocoris punctipes*)—Related to the chinch bug. It is small, dark brown, with thorax covered with shallow black pits, and feeds on lettuce in Florida.

Pumpkin Bug—See **Southern Green Stinkbug.**

Red-and-black Stinkbug (*Cosmopepla bimaculata*)—A small red-and-black bug attacking snapdragon and other plants.

Rhododendron Lacebug (*Stephanitis rhododendri*)—Disfiguring foliage of rhododendron, azalea, laurel, and pieris. The injury is especially prominent when such plants are growing in full sun and negligible when they are well shaded.

Rhododendron lacebugs winter as eggs inserted in lower leaf tissue,

usually in irregular rows along the midrib. The eggs are covered with brownish scabs or shields. Sometime in May (late May or early June near New York City) the eggs hatch into small spined nymphs, with light and dark areas on their flat bodies. These remain on the undersurface of leaves, moving little as they feed, and then with a peculiar sidewise motion. During June they turn into winged adults, 1/8 inch long, with beautiful wings marked in a lace-like pattern of veins. A second brood, appearing in July and maturing in August, provides overwintering eggs.

Sucking by nymphs and adults produces a mottled gray or yellow, or a stippled cream or white, appearance to upper leaf surfaces and covers lower sides with brown, apparently varnished, bits of excrement. Rhododendrons are almost never killed by lacebug injury, but infestations unchecked from year to year result in yellowed, sickly bushes.

Control. Any good contact insecticide applied with pressure and thoroughly coating the undersurface of all leaves will give reasonable control of lacebugs. The usual recommendation is 1½ teaspoons nicotine sulfate and 1 ounce of soap (which means 2 tablespoons liquid insecticide soap) per gallon of water. This spray is applied early in June after most of the nymphs are out but before the adults start moving around. A second treatment (10 to 14 days later) may be needed for late-hatching nymphs and perhaps a July spray for the second brood.

Say Stinkbug (*Chlorochroa sayi*)—A western plant bug distributed east to Kansas. This is a flat, bright green bug, about ½ inch long, with minute white specks and 3 orange spots. It destroys wheat, wilts potato shoots, feeds on asparagus, bean, pea, sunflower, grains, grasses, and weeds.

Snapdragon Lacebug (*Teleonemia nigrina*)—Reported as causing almost total loss to snapdragon and verbena in an Oklahoma greenhouse, and probably more widely distributed.

Southern Green Stinkbug (*Nezara viridula*)—Prevalent in Florida and other Gulf states, similar to the green stinkbug of the North but somewhat larger. It is commonly known as the pumpkin bug. It breeds on cowpeas and other legumes grown as a summer crop in Florida, dwarfing pods, causing drop, and then attacks citrus fruits, sometimes pecans. Although the feeding adult is bright green the hibernating form may be dark olive-green or pinkish. The nymphs are bluish with red markings, and almost circular in form. There are four or five generations a year. In addition to legumes, the southern stinkbug feeds on eggplant, okra, potato, and sunflower.

Control is difficult, but the young can be killed with kerosene emulsion or a strong soap solution. For adults, hand-picking is the only solution, knocking them off into a shallow pan containing a little kerosene, starting early in the morning or on cloudy or rainy days when the bugs are

sluggish. To protect citrus, mow the legume cover crop by the middle of September. Tachinid flies are efficient natural parasites.

Southern Squash Bug (*Anasa armigera*)—Similar to the squash bug, but sometimes feeding and breeding on cabbage and collards.

SPITTLE BUGS (family Cercopidae)—Spittle insects are more like leafhoppers than true plant bugs. The nymphs live in masses of froth; the adults are small, dull-colored, free-flying. Important forms are the lined, pine, and strawberry spittle bugs, which see. They are frequently found on ornamentals and in some years are a nuisance on plants in penthouse gardens far above New York City.

Squash Bug (*Anasa tristis*)—A sucking bug distributed throughout the United States, attacking all vine crops with preference for squash and pumpkin, gourds and melons coming next. (Plate XII, page 143.) During the feeding process, the squash bug apparently injects a toxic substance into the vines, causing a wilting known as Anasa wilt of cucurbits and closely resembling bacterial wilt of cucumbers and other cucurbits, which is a true disease. After wilting the vines turn crisp and black, small plants are killed entirely, and larger vines have several runners affected. Sometimes the bugs are so numerous that no squashes are formed; sometimes they congregate in dense clusters on unripe fruits.

The adult bug is dark brown, sometimes mottled with gray or light brown, hard-shelled, about ¾ inch long. Because it gives off a disagreeable odor when crushed it is commonly called a stink bug, but true stink bugs belong to a related family. Unmated adults hibernate in shelter of dead leaves, vines, boards, or buildings and fly to cucurbits when the vines start to "run." Mating takes place at that time, and clusters of brownish eggs are laid on underside of leaves in angles between veins. Egg-laying continues until midsummer. The eggs hatch in a week or two into young nymphs with green abdomens and crimson legs. Older nymphs are a somber grayish-white with dark legs. There are 5 nymphal instars, or periods between molts, in the 2 months before the winged adult form appears. There is one generation a year in most sections, but two generations a year are reported in Yakima Valley in the state of Washington, which has been having squash bugs in epidemic proportions since 1937.

Control. Sanitation is the primary control measure. Remove all rubbish offering winter protection. Stimulate plant growth with fertilizer. Apply contact insecticides forcefully to undersides of leaves while nymphs are active, since the hard-shelled adults are almost impervious to poisons. To date a pyrethrum dust or a nicotine lime dust has been most satisfactory, but now sabadilla is coming into the picture and may give better results. Summer squashes are more apt to survive attack because they grow

quicker. A tachinid fly is a hard-working parasite of squash bugs and has been introduced into the Yakima Valley area from other sections.

STINK BUGS (family Pentatomidae)—Named for the 5-pointed appendages and called pentatomids as well as stink bugs. They are oval, flattened sucking bugs with both nymphs and adults possessing stink glands. Most of them are plant-feeders but some few are predaceous and should be welcome garden visitors. One species is very effective in demolishing the fall armyworm and is such a successful predator on Colorado potato beetles that it was introduced into France from North America to cope with the beetles which had come there from America some years before.

Strawberry Spittle Bug (*Philaenus spumarius*)—Common on strawberries and sometimes feeding on raspberry and blackberry. Nymphs feeding on stem and leaves in their frothy masses cause distortion of foliage, small and seedy berries. Control with rotenone dust.

Sycamore Lacebug (*Corythucha ciliata*)—Distributed wherever sycamore is found, but confined to that host. The adults are small, 1/8 inch long, wide, flat, with white lace-like wings; nymphs are light-colored, spiny. This bug hibernates as an adult under bark, in crevices, and in spring glues black eggs to underside of leaves. Feeding of nymphs and adults turns foliage white and may seriously injure trees. Spray with nicotine sulfate and soap.

Sycamore Plant Bug (*Plagiognathus albatus*)—Reported from Connecticut, New Jersey, New York, Pennsylvania, and District of Columbia and probably more widely present. Nymphs are yellow-green, with conspicuous reddish-brown eyes. Adults are tan or brown with dark eyes and brown spots on wings. Feeding produces a toxin which turns the leaf areas around feeding punctures red or yellow. These often drop out, leaving holes in foliage.

Spray with nicotine sulfate and soap.

Tarnished Plant Bug (*Lygus pratensis oblineatus*)—Distributed throughout the country and often called legume bug in the Northwest. (Plate V, page 118.) This plant bug is injurious to many vegetables, including bean, beet, cauliflower, cabbage, chard, celery, cucumber, potato, turnip; to fruits—apple, peach, pear, strawberry, sometimes citrus fruits; and to flowers, especially china aster and dahlia, but also chrysanthemum, gladiolus, impatiens, marigold, poppy, salvia, sunflower, verbena, zinnia, and others. The toxin liberated in the plant by feeding processes produces such symptoms as deformed beet and chard leaves, black joints of celery, dwarfed and pitted fruits, blackened terminal shoots of peaches, dahlias with buds dying or opening to imperfect flowers.

The adult tarnished plant bug is small, 1/4 inch long, flattened, oval, brown, irregularly mottled with white, yellow, reddish, and black

splotches, giving a generally "tarnished" appearance, but with a clear yellow triangle marked with a black dot on the lower third of each side. The bugs hibernate in the North as adults among weeds, under leaves, stones, or bark, or in other protected places, flying early in spring to feed on fruit-tree buds, then migrating to other plants to lay eggs in leaf tissue or flowers. The nymphs are very small, greenish-yellow, marked with 4 black dots on the thorax and 1 on the abdomen. The life cycle takes 3 or 4 weeks and there are three to five generations in a season. In the South feeding and breeding continue throughout the winter.

Control. There is no easy, effective method of controlling tarnished plant bugs. Removing weeds and trash in the fall eliminates a number of overwintering adults. Dusting foliage with lime, tobacco dust, or finely ground sulfur provides some repellent effect. Pyrethrum dusts and sprays are recommended for food crops; nicotine-sulfate sprays are helpful; and DDT may be effective.

Walnut Lacebug (*Corythucha juglandis*)—Occasionally abundant on walnut, butternut, basswood, and linden. This is a pale yellow or brown lacebug with a brown band on the wings, and can be controlled with an early application of a contact insecticide.

Western Leaf-footed Bug (*Leptoglossus zonatus*)—Ranging from New Mexico into Arizona and southern California; a relatively large bug, ¾ inch long, brown with 2 yellow spots on thorax and leaf-like enlargement of hind legs. It breeds on pomegranate and is thought to spread heart-rot disease of pomegranate. It may damage orange trees, or limes, or cotton, date, or watermelon.

Willow Lacebug (*Corythucha salicis*)—A small lacebug with whitish body and brown spots, infesting willows. A similar western species also feeds sparingly on apple.

BUTTERFLIES

Most species of butterflies that are injurious to plants are more commonly known in their larval state and are called either caterpillars or worms, and so for convenience all butterfly pests are treated in one or the other group. See Caterpillars; Worms.

CANKERWORMS

Cankerworms are the larvae of small moths, of the family Geometridae, the scientific name meaning about the same as our common term of inchworm or measuring worm. There are a number of species in this family, but only 2 are familiar to gardeners under the name of canker-

worm—the fall cankerworm and the spring cankerworm, obnoxious pests of fruit and shade trees. Other species in this group are known as looper or spanworms. They all move by a series of looping movements, drawing up the abdomen to the thorax in a loop, grasping the support by the prolegs (false legs at the end of the body), loosening the thoracic legs, stretching the body forward, and so on in rapid succession. They also, at times, let themselves down on a thread of silk.

Fall Cankerworm (*Alsophila pometaria*)—So named because the adults appear in autumn. This measuring worm is distributed generally across the United States, a threat to fruit trees—apple, apricot, cherry, plum, prune, and other fruits—and to shade trees, especially oak and elm, sometimes basswood or linden, birch and maple. In California even geraniums, grown outdoors as standards or in window boxes, may be attacked.

The moths emerge from pupae in the ground in late fall, after there have been freezing temperatures. The males are light gray with a 1¼-inch wingspread; the females have gray bodies, about ½ inch long, but they are wingless. (Plate XVIII, page 175.) They crawl up tree trunks to deposit grayish eggs in a loose, flat mass on main trunk or branches or in a circle around smaller twigs. The eggs hatch the following spring, about the time leaves unfold, and the larvae feed on foliage until June.

These measuring worms are brownish above, green below, have 3 narrow white stripes along the body above the spiracles and a yellow stripe below. They have 3 pairs of prolegs (*false feet*) at the end of the body in addition to the 6 true legs. They often drop down from leaves on a silken thread, climbing up again to resume feeding. Toward the end of the feeding period they may eat conspicuous holes in leaves of rhododendron and other shrubs growing under or near the favored food plants. When full-grown they drop down to the ground and pupate in a silken cocoon a few inches deep in the soil.

Control. Banding trees with a sticky material, such as tanglefoot, to prevent the wingless female from crawling up the trunk to lay her eggs, is a practice less popular now than some years ago, for it has been determined that young cankerworms are carried by the wind from unbanded trees near by and that the actual foliage injury is reduced by only a small per cent. Also, unless properly applied on a paper band or a special material known as balsam wool so that the tanglefoot does not come in direct contact with the bark, there may be serious injury to the tree. The band should be in place by late September to catch moths of fall cankerworms and the sticky surface should be scraped or renewed as often as necessary to prevent late arrivals from crawling up on the backs of their fallen comrades.

Spraying is far more effective as a control measure. Property owners, in years when a heavy infestation has been forecast, should arrange to have trees sprayed with lead arsenate (3 to 5 pounds per 100 gallons water) as soon as the leaves are out far enough to hold the poison. For woodland areas spraying or dusting by airplane has proved practical.

Of the many natural enemies of cankerworms ground beetles should be recognized as special friends of man. Do not kill these black, brown, or greenish iridescent shield-shaped, strong-jawed beetles when you find them lurking under stones or climbing trees in search of succulent caterpillars.

Spring Cankerworm (*Paleacrita vernata*)—Occurring generally east of the Rocky Mountains and in California and Colorado. This is one of our oldest native pests, having been known in New England for more than 200 years. It apparently prefers apple and American elm (slippery or red elm appears to be immune) but it is also devastating to oak and 40 other fruit and ornamental trees. Cankerworms appear in cycles, being very abundant for 2 or 3 years, almost completely defoliating trees in a certain area, feeding in such numbers that you can actually hear the leaves being crunched, and dropping down on unwary pedestrians. Then they almost disappear for a few years and gradually recruit their armies for another peak of abundance. Trees defoliated 2 or 3 years in succession may die.

The moths appear in early spring, sometimes on a warm day in February, more often in March. The females are spidery and wingless like the fall cankerworm but have a dark stripe down the back. The male moths are silky gray with 3 transverse dark lines on the front wings. They often appear in attics about the time the females are climbing trees to mate and lay brownish-purple eggs in an irregular mass under loose bark on main trunk or branch. The caterpillars, 3/4 to 1 inch long, are greenish or black, dark underneath but with a yellow stripe on each side of the abdomen and just below the spiracles, and often 3 broken lines of yellow above the spiracles. They differ from fall cankerworms in having only 2 pairs of prolegs instead of 3.

Control. The same measures are taken as for the fall cankerworm, except that if banding is practiced the tanglefoot should be renewed in February.

These inchworms, both the fall and spring varieties, are far more dangerous than the better advertised tent caterpillars. Spring foliage spraying is very important. Pyrethrum sprays can replace lead arsenate on tender stone fruits, and the regular apple-spray schedule for codling moth will also control cankerworms.

CASEBEARERS

Casebearers (family Coleophoridae) are moths whose larvae live in portable cases and feed or mine in leaves, fruits, flowers, or seeds. This is a small family and most of the American species belong to 1 genus.

Birch Casebearer (*Coleophora salmani*)—First found in Maine in 1927 and spreading rapidly. All varieties of birch and speckled alder are attacked. The moth is grayish-brown, with fringes on narrow hind wings, and very small. The caterpillar is light yellow to green, with a black head, 1/5 inch long, living in a small brown cylindrical case, and mining and cutting holes in leaves. Badly mined foliage dries and trees appear scorched; buds may be eaten, causing dieback of twigs and limbs. There is one generation with hibernation as larvae in cases on twigs.

Control. Lime-sulfur applied at 1 to 8 dilution (dormant strength) in early spring seems effective against overwintering larvae. Nicotine sulfate plus 1/2 per cent Penetrol destroys eggs and young larvae in early August.

California Casebearer (*Coleophòra sacramenta*)—Willow is the normal host, but the larvae also commonly feed on almond, apricot, apple, cherry, peach, pear, plum, prune in San Francisco Bay region of California. The moth is bluish-white with gray scales, 5/8 inch wingspread; the larva is orange, making a black case widened at bottom with a wing-like projection. There is one generation.

Spraying with lead arsenate gives control.

Cherry Casebearer (*Coleophora pruniella*)—Normally feeding on wild cherry but reported injuring cultivated cherries in the Middle West and Oregon. It winters in its case attached to twigs, moving to young foliage in spring, producing skeletonized and dead areas as it grows and enlarges the case with leaf tissue. Pupation is in late spring. Moths lay eggs on underside of leaves and new caterpillars are making overwintering cases by late summer. There are several natural parasites of this casebearer.

Cigar Casebearer (*Coleophora fletcherella*)—Distributed generally in apple-growing regions, attacking apple, except Jonathan variety, pear, plum, cherry, and haw. The light brown partly grown larva hibernates inside a cigar-shaped, brownish-gray silken case, about 1/4 inch long, attached to twigs or branches, and starts feeding as buds unfold in spring. It feeds until July, making blotch mines between the leaf surfaces, then pupates and produces mottled gray moths with narrow fringed wings, 1/2-inch wingspread. Eggs are laid on underside of leaves with larvae appearing in late summer to make new cases.

Control. The ordinary apple-spray schedule will take care of casebearers. Lead arsenate and nicotine applied at the cluster bud stage is the most important spray.

Elm Casebearer (*Coleophora limosipennella*)—A European insect established in the East, confined to elms, particularly Scotch and European varieties. The shape of the case and life history of the insect are like that of the cigar casebearer. The moth is buff-colored, gray-marked. The larva cuts a hole in a leaf and then mines a rectangular area. Elms sprayed with lead arsenate for cankerworms and elm leaf beetles will not suffer from this pest.

Larch Casebearer (*Coleophora laricella*)—A European insect recorded here in 1886, present in northeastern United States and confined to eastern larch (tamarack) and European larch. The moth is silver gray; the larva, dark reddish-brown with black head, mines in April and May. When abundant it causes the needles to turn white and die, checks the growth, and weakens the trees. Moths appear in late May, lay ribbed cinnamon-colored eggs on leaves. Young larvae live in mines in leaves until September, when they cut off the end of the needle for a winter case.

Control. Spray with dormant-strength lime-sulfur in spring before growth starts. Several parasites are helpful.

Maple Casebearer (*Paraclemensia acerifoliella*)—A native pest of sugar maple, sometimes beech in the Northwest. The moth has blue fore wings with brown fringed hind wings; the cases are circular and the foliage often nearly destroyed. Hibernation is on ground as pupae.

Control by raking and burning leaves in fall and spraying with lead arsenate in June.

Pecan Cigar Casebearer (*Coleophora caryaefoliella*)—Found from the Gulf states to New England on pecan, hickory, and black walnut. The moth is brownish, the larva reddish with a black head. Mined areas turn brown and sometimes drop out, leaving holes in foliage. The leaves may also drop in some cases. Spray hickories with arsenate of lead at 3 pounds per 100 gallons water; spray pecans at rate of 2 pounds lead arsenate per 100 gallons plus 6 pounds hydrated lime.

Pecan Leaf Casebearer (*Acrobasis juglandis*)—Present in the southern portion of the pecan belt from Florida to Texas. The moths are variable, white, gray, brown, or black; the larvae feed on young buds and leaves. Spray with calcium arsenate and bordeaux mixture in July.

Pecan Nut Casebearer (*Acrobasis caryae*)—Present in Alabama, Florida, Georgia, Mississippi, Texas, and Louisiana. This is considered the most serious pecan pest. The larva is olive-green, ½ inch long; the moth is dark gray with ¾-inch wingspread. Larvae winter in cases around buds, attacking tender shoots in March and April, feeding within the shoots, pupating in tunnels. The moths, emerging in May, deposit eggs on the nut; the young larvae spin a web around several nuts and enter to feed. This brood pupates inside the nut, with moths appearing in June and July.

Control is difficult, but 2 applications of lead arsenate timed for each brood of larvae have given satisfactory results.

Pistol Casebearer (*Coleophora malivorella*)—Found from the Mississippi Valley eastward. This is similar to the cigar casebearer and is usually a minor pest of apple and other fruits. The larva winters in its pistol-shaped case attached to a twig, injuring buds in spring and later mining leaves. Eggs are laid on leaves in June. (Figure 56.)

One or two applications of a summer oil to kill eggs give control. There are many parasites.

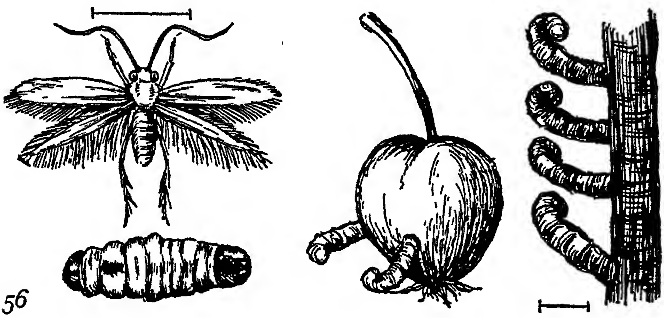


Figure 56

Pistol casebearer, showing moth, larva, and larval cases

CASECUTTERS closely resemble casebearers. For Sour-gum Casecutter see **Tupelo Leaf Miner.**

CATERPILLARS

Caterpillars are the worm-like larvae of moths and butterflies. Some insects are commonly called moths, after the adult form, and so are discussed under Moths. Some have special names, such as cankerworm, casebearer, cutworm, earworm, fruitworm, hornworm, spanworm, webworm; and some are just called worms. After relegating all these to their particular categories we have some insects that still go by the name of caterpillars, a few called butterflies, and a few known by various miscellaneous names to be discussed in this section.

Moths and butterflies belong to the order Lepidoptera, the name meaning scaly wings. The adults have 2 pairs of membranous wings covered with overlapping scales, which give the brilliant colors. The mouth parts are adapted for sucking, consisting only of a long coiled tongue. They feed on liquid foods, chiefly nectar from flowers, and are of great use in pollinating or cross-pollinating many plants. They are injurious to plants

only in their larval stage, practically all caterpillars being vegetarians; clothes moths and a few others are exceptions rather than the rule.

There are thousands of caterpillars, all with similar structure. (Figure 57.) They have chewing mouth parts and cylindrical bodies composed of 13 segments besides the head. The first 3 segments each have a pair of jointed legs terminating in a single claw. Usually 2 to 5 of the abdominal segments have unjointed fleshy projections from the body called prolegs, armed with a number of fine hooks, known as crotchets, for holding on to a leaf or twig. There is also, in most cases, a spinneret near the mouth for making silk.

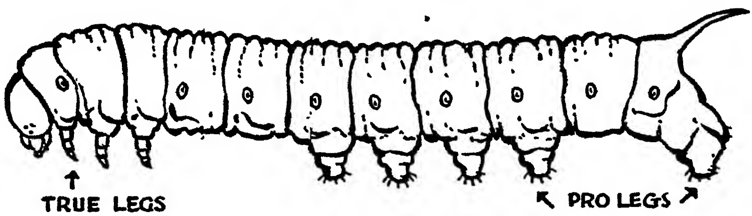


Figure 57 *Diagram of a caterpillar*

The pupae of moths are usually wrapped in a cocoon—a silken case made from saliva secreted by the full-grown caterpillar. Some lie buried in the soil and a few are formed in tunnels in wood. Many moths are night fliers. Their antennae are varied but never enlarged to form a club.

Butterflies are day fliers, and have their antennae enlarged into a club at the tip. Except in the group of skippers the abdomen is slender. The pupae are usually naked "chrysalids" fastened to plants or other supports with 1 or 2 strands of silk.

Alfalfa Caterpillar (*Colias philodice eurytheme*)—A southwestern insect occasionally present on garden peas, beans, and other legumes. The caterpillar is dark green with a pale yellow or white line down each side, often defoliating alfalfa but sometimes other legumes. The butterflies are sulfur-yellow, less frequently white, with wings tipped with wide black bands. Parasites and a wilt disease hold this caterpillar in check, but sulfur dust gives control when necessary.

Alfalfa Looper (*Autographa californica*)—Causes sporadic damage on the Pacific coast. This caterpillar is a general feeder, injuring not only alfalfa, but many cereal and truck crops, fruit, flowers, and ornamental trees and shrubs. The looper is about an inch long, dark olive-green, with a paler head and 3 dark lines along the back. The gray moth, with a silver mark on each fore wing, appears at dusk and early evening to visit flowers.

Control with rotenone or pyrethrum dusts.

Avocado Caterpillar (*Amorbia essigana*)—Limited to California and chiefly to avocado. This caterpillar belongs to the Tortricidae or leaf-roller family and was first noticed in California in 1922. Scarring of young fruit is more important than skeletonizing of leaves. Larvae are yellowish-green with a dark dot on each segment. Moths have reddish-brown fore wings spreading to 1 inch.

Control with lead-arsenate sprays as for the omnivorous looper.

Banded Woolly Bear (*Isia isabella*)—Generally distributed. This is the familiar brown, densely hairy "hedgehog" caterpillar which rolls into a ball when disturbed, or for hibernating in some protected place. The caterpillars range up to 2 inches long; some are brown or red in the middle and black at both ends, and some are all brown. Adult moths are yellow, 1½ to 2 inches across the wings, and have a few dusky spots on the wings and black spots on the abdomen. (Plate XX, page 207.)

Control. Use lead-arsenate or cryolite sprays, 2 ounces to 3 gallons water; or dusts, 1 part arsenate to 9 of gypsum or talc when necessary.

Black Swallowtail, or **Celery Caterpillar,** or **Celery Worm** (*Papilio ajax*)—This is probably the most important member of the swallowtail family, occurring all over the United States east of the Rocky Mountains, feeding on celery, carrot, caraway, dill, parsnip, parsley, and other members of that family, but not considered a major pest.

The caterpillar is a striking creature, 2 inches long, with a black cross-band in each segment and just back of the head an opening for 2 soft forked orange horns. (Plate XIX, page 206.) When disturbed the larva protrudes these horns and gives out a sickeningly sweet odor. The butterfly has a wingspread of 3 to 4 inches, black wings with 2 rows of yellow spots, hind wings with blue shadings between the rows, a black orange-bordered spot on the inner margin, and a projecting lobe (the "swallow-tail").

In the North the winter is passed as a tan chrysalid suspended from host plants; in the South the butterflies live over winter. Eggs are laid singly on leaves of food plants, hatching in 10 days, the larvae feeding for 10 days to several weeks, occasionally stripping plants of foliage. There are two generations in the North; more in the South.

Control. Hand-picking is usually all that is needed. Young plants can be dusted with lead or calcium arsenate, changing to rotenone as they mature and approach the edible stage.

Cabbage Caterpillars—Accepted common names for the 3 common caterpillars attacking this host are Cabbage Looper, treated here, Imported Cabbage Worm (see Worms) and Diamondback Moth (see Moths).

Control measures are practically the same for all 3, so there is little need for you to worry about which worm is feeding on your cabbage or broccoli.

Cabbage Looper (*Autographa brassicae*)—A native species common throughout the country. This caterpillar attacks all members of the cabbage family—broccoli, Brussels sprouts, cabbage, cauliflower, collards, horseradish, kale, kohl-rabi, mustard, radish, turnip, and also feeds on beet, celery, lettuce, parsley, pea, potato, spinach, tomato, and such flowers as carnation, nasturtium, and mignonette. The looper winters as a green to brown pupa wrapped in a cocoon attached by one side to a plant leaf, and transforms in spring to a moth with mottled brownish front wings with a small silvery spot in the middle and paler brown hind wings, spreading to nearly 1½ inches.

The females lay many small round, greenish-white eggs, singly, on upper surface of leaves. The larvae are greenish with the body tapering to the head, a thin white line along the body above the spiracles and 2 others down the back. There are 3 pairs of club-shaped prolegs and the body in front of these is usually humped or looped up. The looper feeds for 2 to 4 weeks, then spins a cocoon. There may be three or more generations in a season.

Control. Dust plants with cryolite when they are small, changing to rotenone or pyrethrum dust as soon as heads form. In the small garden it is easier to dust with rotenone from the beginning. A wilt disease destroys many loopers late in the season.

California Tent Caterpillar (*Malacosoma californica*)—Common in California. This species constructs large tents like the eastern tent caterpillar. It infests oak in particular, but tents are also found on almond, apple, apricot, ash, California Christmasberry, California coffeeberry, ceanothus, cherry, cottonwood, currant, hazel, madroña, plum, prune, redbud, willow, and other fruit and forest trees.

The caterpillars are reddish-brown or tawny above, paler underneath, with a blue line on each side. A similar species, known as the blue-sided tent caterpillar (*Malacosoma constricta*), has an orange-brown body with blue sides, feeds on oak, shrubs, and fruit in Arizona, California, and Oregon.

Control. Cut off and burn infested branches; remove twigs with egg masses during winter; dust young caterpillars with sulfur; spray or dust trees with lead arsenate.

Celery Caterpillar—See **Black Swallowtail.**

Celery Looper (*Autographa falcifera*)—General throughout the country, and much like the cabbage looper. The moth is large, with purple-brown fore wings; the larvae are pale green, with light and dark stripes,

up to 1 inch long. They feed on celery, beets, lettuce, and other succulent plants and weeds.

Checker Spot, or **Chalcedon Butterfly** (*Euphydryas chalcedona*)—Adults have black wings covered with many yellow spots. Caterpillars are large, bluish-black with small orange markings and numerous large black compound spines. They feed on aster, buddleia, chrysanthemum, Shasta daisy, monkeyflower, penstemon, veronica, and other plants. They may web the plants as they feed and are quite a garden pest in the Rocky Mountain and Pacific states.

Control by spraying with nicotine sulfate, 1½ teaspoons per gallon of water.

Columbine Skipper (*Thanaos lucilius*)—A stout, velvety-green caterpillar with a black head, 1 inch long, apparently restricted to columbine in its feeding. Holes are eaten out of some leaves and others are folded up around resting caterpillars or pupae. The adult skipper is a day flier like a butterfly, but moves in sudden darts.

Convict Caterpillar (*Xanthopastis timais*), also called **Spanish Moth Caterpillar**—This species has spider lily as its natural host, but is a special pest of amaryllis, feeding also on narcissus and similar plants. The larva is black, with creamy bands around the body like convict stripes; about 2 inches long. It skeletonizes leaves and then eats stalks. The moth is pinkish-cream to white with wings spreading almost 2 inches. Control by dusting with lead or calcium arsenate.

Eastern Tent Caterpillar, also called **Apple-tree Tent Caterpillar** (*Malacosoma americana*)—Present throughout eastern United States and west to the Rocky Mountains. Black cherry, chokecherry, and apple are favored food plants, but when these are scarce it makes ugly nests on hawthorn, plum, birch, beech, elm, maple, oak, poplar, willow, and other fruit and ornamental trees. The periods of greatest abundance and devastation appear at about 10-year intervals.

The winter is spent in a dark brown, varnished collar or belt of eggs encircling twigs. (Plate XVIII, page 175.) The young larvae, hatching very early in March, gather in a fork of the limbs to spin their large webby nest. They leave it during the day to feed on foliage, but return at night or in rainy weather. They are hairy caterpillars, generally black with a white stripe down the back, brown and yellow lines along the sides, and a row of oval blue spots. They are full-grown (2 inches long) in 4 to 6 weeks, and are often seen in numbers crawling down the sides of houses or feeding on roses and other shrubs before spinning dirty white cocoons on tree trunks or fastened to buildings.

The moths, light reddish-brown with 2 diagonal stripes across each fore wing, emerge in about 3 weeks. Each female lays one egg collar

around a twig, covering it with a sticky substance which hardens and glistens like varnish. There is one generation a year, at least 9 months being spent in the egg stage.

Control. Apples are protected by the regular spray schedule used for codling moths. Wild cherries growing near apple orchards should be removed. Young caterpillars can be killed by dusting with sulfur or adding lead arsenate to a delayed dormant-oil spray. Never use sulfur and oil on the same tree within a month of each other. Spraying or dusting ornamentals with lead arsenate will protect foliage from older caterpillars, but if the egg masses are systematically pruned out during the winter and the nests wiped out when first started, spraying should not be necessary. Burning out nests with a flaming torch is almost always harmful to the tree and very often starts brush fires, but the nests can be readily removed by twisting a brush fastened to a stick, or using a rag soaked in kerosene and then burning the mass. Sometimes the caterpillars can be killed in the nest by forceful spraying with a contact insecticide.

Tent caterpillars have many natural enemies—ground beetles and other predators, egg parasites, a wilt disease—all of which account for the periodic rise and fall in abundance. These natural enemies should not be solely relied on for control, but sometimes it helps to work along with nature. If the twigs bearing egg masses are cut off, encased in fine wire mesh and left in the open instead of being burned, it gives beneficial parasites a chance to emerge.

Eight-spotted Forester (*Alypia octomaculata*)—An eastern insect ranging west to Colorado, feeding on wild and cultivated grapes and Virginia creeper. The adult is a black moth, wings spreading to 1½ inches, with 2 yellow spots on each fore wing and 2 white spots on each hind wing. The caterpillar has a brownish body banded with white, orange or red, an orange head with black spots, orange prolegs, and black true legs, about 1¼ inches long. It is completely voracious, sometimes stripping leaves of a Virginia creeper vine. It winters as a pupa in soil.

Control by hand-picking is usually sufficient; if very numerous, spray with lead arsenate.

Florida Fern Caterpillar (*Callopistria floridensis*)—Native to tropical America and introduced into northern greenhouses on infested plants from Florida. It apparently feeds only on ferns, chiefly nephrolepis and adiantum, and works at night or on cloudy days, stripping leaflets from old growth, devouring new growth entirely. The caterpillars are at first pale green, later velvety black, 1½ inches long. During the day they are concealed in the crown of the fern, along the midrib of a frond, or in the soil. They pupate underground in an oval cocoon, the adult moth, with brown patterned wings, emerging in about 2 weeks.

Control by hand-picking caterpillars at night, and with a pyrethrum dust or spray.

Forest Tent Caterpillar (*Malacosoma disstria*)—A native pest of forest, ornamental, and fruit trees, widely distributed from the Atlantic to the Pacific. This caterpillar is much like the eastern tent caterpillar but forms no real tent. It seems to prefer oak, maple, or poplar, but includes apple, birch, boxelder, cherry, hawthorn, peach, pear, plum, prune, quince, rose, willow, and other trees in this category.

The caterpillars are gregarious, armyworm style, living in large colonies on larger limbs and tree trunk but not making a silken nest. They winter in an egg mass, but the egg belt is squarely cut off at the ends instead of being rounded down to the twig. The caterpillars, 1½ to 2 inches long, are bluish or black, spattered with black dots and points, with a row of diamond-shaped spots alternating with small white spots down the back, and also pale longitudinal yellow stripes; they are sparsely clothed with soft hair. They eat ravenously in early spring for about 6 weeks, spinning silken threads but not making a tent. In June or July white cocoons are spun within a leaf or attached to fences or ground objects. The moths emerge in late June or July to lay 200 eggs in a band around a twig. There is one generation. The moths are brownish-buff with 2 dark oblique lines across the fore wings and a wingspread of 1½ inches for the female; somewhat less for the male.

Control. There are many natural enemies to keep this particular caterpillar in check—parasitic wasps and flies, ground beetles, 2 species of bugs, and birds. Inspect ornamental trees for egg masses and cut them off. Spray with lead arsenate for serious infestations. Fruit trees sprayed with dormant lime-sulfur are reported free from forest tent caterpillars.

Great Basin Tent Caterpillar (*Malacosoma fragilis*)—Common in the West, especially at high altitudes. The caterpillars have tawny hairs on a black body, blue and orange markings. They are omnivorous feeders, webbing orchard trees and ash, aspen, ceanothus, cottonwood, and many others.

Hemlock Looper (*Ellopia fiscellaria*)—An enemy of forest and home plantings. The looper, often called a spanworm, is distributed from northern Atlantic states to Colorado, and may attack balsam, fir, arborvitae, beech, elm, red and white pine, white birch, soft maple, and willow as well as hemlock. The larvae are greenish-yellow to gray with a double row of small black dots on the back. They may occur in such numbers that trees are defoliated and killed or the symmetry is marred. Evergreens are more seriously injured than deciduous trees.

The hemlock looper winters as single eggs or small masses glued under loose bark or on needles. The larvae hatch in early June and feed on

needles from the top of the tree downward, dropping on a thread of silk when disturbed. They pupate under bark or in protected places. Tan-gray moths with purple markings appear at the end of August and fly for several weeks.

Control. Many parasites help to check these loopers. Spray shade and ornamental trees with lead arsenate in time to kill the young larvae.

Hickory Horned Devil (*Citheronia regalis*)—Our largest native caterpillar. It is 4 to 5 inches long, larva of the regal moth, which has a wingspread of 4 to 6 inches. It is found from Massachusetts to Louisiana and Texas, but is not abundant enough to do much damage. It feeds on hickory, black walnut, butternut, sycamore, sweet gum, ash, persimmon, lilac, sassafras, sumac, and cotton.

The caterpillar has a green body with black spines, and just back of the red head are the devil's horns, very long reddish spines bending backward and tipped with black. The moth has dusky olive fore wings spotted with yellow, veins bordered with red scales, hind wings orange-red spotted with yellow.

Control measures are usually unnecessary.

Monarch Butterfly (*Danaus plexippus*)—Common orange-brown butterfly with wings bordered and tipped with black. Eggs are laid on various species of milkweed and larvae feed on them. Caterpillars are yellow-green marked with numerous crossbands of black. The jade-green chrysalid is held by a belt with spots of gold.

Mourning-cloak Butterfly (*Nymphalis antiopa*)—A common species found all over America, and one of the few butterflies with injurious larvae. They are known as spiny elm caterpillars and are black, covered with small white dots and a row of orange or red spots along the back and bearing several lengthwise rows of black branched spines. They feed on elm, poplar, and willow.

The butterflies have purplish-brown wings bordered with a wide yellow stripe inside of which is a row of blue or purple spots; they spread 2½ to 3½ inches. They hide away in the fall in nooks and crannies, including tree cavities, are on the wing on sunny days in March, but wait until May to deposit sculptured eggs in masses of 300 to 450 around a small branch. When the larvae hatch they feed in groups, often defoliating a branch. They transform to chrysalids in late June or early July and butterflies emerge in a few days to lay eggs for a second brood of caterpillars in August.

Control. Cut off and burn infested branches as soon as noticed; spray with lead arsenate when larvae are young. Several wasps are parasites, and yellow-billed cuckoos and some bugs are predators.

Oak Looper (*Ellopia somniaria*)—Periodically very destructive to oak

in Oregon, Washington, and British Columbia, where it takes the place of the eastern hemlock looper. The caterpillars are pale brown mottled with black spots, up to 1¼ inches long. Every 3 or 4 years they get so numerous it is impossible to walk under trees without being covered with them; the trees look as if they had been burned.

The moths are yellow to dark brown, dotted with darker scales. In October they may completely cover limbs and branches of trees. There is one generation a year, with winter spent in the egg stage.

Spray shade trees thoroughly with lead arsenate.

Omnivorous Looper (*Sabulodes caberata*)—A native of, and apparently confined to, California. This measuring worm is most serious as an avocado pest, often being numerous enough to strip the trees of all foliage; but it also feeds on acacia, alder, aralia, boxelder, buckeye, California laurel, California Christmasberry, cherry, chestnut, clematis, daisy, elm, English ivy, eucalyptus, geranium, ginkgo, grevillea, groundsel, honeysuckle, lemon, lemon verbena, magnolia, maple, olive, orange, passion vine, pecan, pepper tree, privet, rose, sumac, sycamore, tecoma, violet, black walnut, willow. Truly it is well named omnivorous.

The adult moth is dull brown or yellow, with a wingspread of 1¾ to 2 inches. It is nocturnal but may be found during the day on underside of leaves, where it lays its clusters of eggs. The larvae vary from yellow to pale green or pink, with yellow, brown, or green stripes on sides and back and with black markings over the body. The pupa is usually webbed between 2 leaves, or inside a leaf folded over. There may be five to six generations a year.

Control. Spray or dust with lead arsenate in years when loopers are numerous. In some years a fungus disease, together with parasitic wasps, keeps them sufficiently in check.

Orange Dog (*Papilio cresphontes*)—A common and destructive butterfly attacking citrus in Florida. It is called orange dog because one end of the caterpillar looks like the nose of a dog with 2 black spots on the thorax for eyes. It is 2½ inches long, dark brown with blotches of light yellow. When disturbed, orange-red horn-like processes are protruded from a fold in the skin just back of the head and a strong odor given off. The dogs feed voraciously on foliage, often defoliating a young tree in 2 or 3 days. The eggs, white with a reddish tinge, are laid singly on new shoots, about February, hatching in 10 days. The adult is a large, very common Florida butterfly marked with yellow and black.

The best control is to pick the larvae off nursery and young orchard trees by hand.

Orange Tortrix (*Argyrotaenia citrana*)—An important orange pest in California. The dirty-white, brown-headed caterpillar feeds in the ripe

fruit of oranges, burrowing in the fruit, causing premature drop, and leaving avenues of infection for decay organisms. Young oranges are scarred around the button. Grapefruit may also be infested, but it is not grown so much in regions where the tortrix is injurious. In addition to citrus fruits, the larvae feed on and web the leaves of goldenrod, oak, black walnut, willow, and occasionally work on acacia, apricot, asparagus, begonia, cineraria, Job's tears, eucalyptus, ferns, geranium, Jerusalem cherry, lantana, lavender, orange, penstemon, rose, and wandering Jew.

The moths are fawn or gray with darker mottlings on the fore wings. The eggs are cream-colored sculptured disks, laid in overlapping masses on both leaf surfaces. There are two to four generations a year.

Control with cryolite sprays or dusts.

Painted Beauty (*Vanessa virginiensis*), or **Hunter's Butterfly**—Ranging throughout North America. The caterpillars are alternately banded dark purple, yellow, and green, with a short row of silver-white spots on each side of the back. They feed on thistles, hollyhock, mallow, malva, forget-me-not, senecio, sunflower. The butterflies are tortoise marked, with 2 large eyespots on hind wings.

Painted Lady (*Vanessa cardui*), or **Thistle Butterfly**—Said to be the most widely distributed butterfly in the world. It occurs throughout North America and is very abundant in the West, sometimes appearing in great migratory flights. The adult is orange-red with black and white markings, 2½ inches across the wings. The caterpillar varies from green to brown mottled with black, has a light dorsal stripe and a yellow stripe along each side, and grayish spines. It is 1¼ inches long. The larvae feed on hollyhocks as well as thistles, mallows, and weeds. The chrysalids are iridescent and seem to have been dipped in gold. There are at least two broods a year with butterflies in evidence from early spring until late fall.

Pine Butterfly (*Neophasia menapia*)—Chiefly a pest of coniferous forests in higher mountains of the West, where great areas of yellow pine and Douglas fir are sometimes defoliated. The adults are white marked with black, the larvae green with white stripes.

Pipe-vine Swallowtail (*Battus philenor*)—Caterpillars are dark brown with four rows of orange to coral spots and soft horn-like projections. They seem to feed on dutchman's pipe wherever it is grown. Adults are blue-green butterflies with white spots on under margin of fore wings and yellow and orange spots on hind wings.

Control by spraying with lead arsenate.

Poplar Tent Maker (*Ichthyura inclusa*)—Distributed from New England to Colorado, attacking poplars and willows. The caterpillars are black mottled with gray and striped with yellow and brown. They have a pair of black tubercles on first and eighth abdominal segments, are about

1¼ inches long. They are gregarious and make silken nests by webbing several leaves together or folding over one leaf. They feed on the surface and gradually add other leaves to the nest. The winter is spent as pupae under leaves, with moths appearing in early spring. The latter are brownish-gray with 3 irregular white lines bordered on the outer edge with red on the fore wings. There is a waxy band on hind wings and they spread to just over an inch.

Control. It is usually possible to cut out whole colonies and destroy by burning. Spraying with lead arsenate when caterpillars are small is satisfactory. A wilt disease and a parasitic fly help to check this pest.

Puss Caterpillar (*Megalopyge opercularis*)—One of the stinging oak caterpillars, a native found from Virginia to Texas on oak, hackberry, and sycamore, even on English ivy. Gardeners should beware of this inch-long larva, covered with long, soft, reddish-yellow hairs interspersed with short, stiff stinging spines. If a caterpillar falls on the neck there may be severe irritation and pain; if on the wrist the whole arm may swell. Children are more seriously injured than adults. Dr. Herrick gives the following formula for soothing the nettling caused by stinging caterpillars:

Menthol 10 grains
Zinc oxide 2 drams
Aq. calcis 8 ounces
Acid carbolici 15 drops

Lead-arsenate sprays will kill the caterpillars if they are numerous enough to require control.

Range Caterpillar (*Hemileuca oliviae*)—A range pest on wild grasses in New Mexico and Colorado, but sometimes infesting corn and other cultivated crops. Larvae are yellow, gray, or black, densely covered with coarse poisonous spines with red or black heads and with white spiracles encircled with a black line.

Red-humped Caterpillar (*Schizura concinna*), often called **Red-humped Apple Worm**—Distributed over most of the United States. The larvae are yellow or reddish with a bright red head and hump on the fourth segment, dark tubercles on each segment, and the body lined longitudinally with white, brown, red, and black. (Plate XX, page 207.) They are about an inch long and rest with the rear end of the abdomen elevated. These caterpillars feed on both fruit and ornamental trees, stripping foliage of apple, apricot, aspen, bayberry, birch, blackberry, cottonwood, cherry, dogwood, hawthorn, hickory, huckleberry, locust, pear, persimmon, plum, poplar, prune, rose, sweet gum, willow, black and English walnuts. The moth is grayish-brown, 1¼ inches across the

wings. The winter is spent in a chrysalid enclosed in a thin cocoon in the soil or under trash. In warm climates there is a spring and a fall generation.

Control. Cut out and burn entire colonies when larvae are small, or spray with lead arsenate, pyrethrum, or rotenone.

Saddleback Caterpillar (*Sibine stimulea*)—Another stinging caterpillar widely distributed throughout the Atlantic states. It feeds on oak, cherry, sometimes other trees. It is very distinctive, about an inch long, flat underneath, rounded above, reddish but with a pea-green patch, the saddle blanket, in the middle of the back, and on that blanket the saddle, which is a broad purple-brown patch often edged with white. There are fascicles of spines along the sides and 2 large tufts of spines at both ends. The irritation is severe. See Puss Caterpillar for formula to use on rash.

Saddled Prominent (*Heterocampa guttivitta*), also called **Antlered Maple Caterpillar**—Common in the Atlantic states. It prefers beech and maple but feeds also on apple, birch, and oak, occasionally on blackberry, cherry, poplar, spirea, witch hazel. The young larva bears 9 pairs of horns, starting at the head with a large branched pair, like antlers, but the mature larva has no horns. It is green to brown or yellow, with a reddish-brown saddle spot on the middle of the back. The moth is olive-gray with darker waxy areas and dark dots. In certain seasons New England woodlands may be defoliated by this pest. At such times it may also be found on shade trees, but it is not considered a serious pest of ornamental trees.

Parasites usually take care of the saddled prominent; shade trees can be sprayed with lead arsenate if the abundance warrants the labor and expense.

Salt-marsh Caterpillar (*Estigmene acrea*)—Generally distributed over the country. The caterpillars are very hairy, gray when young, then black with yellow broken lines and cinnamon-red hairs, up to 2 inches long. At times, usually late summer, they may be as abundant as armyworms, eating everything in sight—sugar beets, beans, other vegetables, and flowers. The adults have white wings with black spots and an orange black-spotted abdomen.

Spray or dust with lead arsenate or cryolite.

Silver-spotted Skipper (*Proteides clarus*)—One of the largest of the skipper butterflies, feeding on locust, especially rose-acacia. The caterpillar is leaf-green with a brown head and it fastens together several leaflets for a case in which it lives and feeds. The butterfly is brown and yellow with white quadrangular spots on the fore wings. All wings are sharp-pointed.

A lead-arsenate spray will prevent defoliation.

Spiny Elm Caterpillar—See **Mourning Cloak Butterfly.**

Striped Garden Caterpillar (*Polia legitima*)—Generally distributed, more abundant in late summer. This is a dark, yellow-striped cutworm, similar to the zebra caterpillar, with some preference for crucifers. The moth is grayish with an irregular pattern.

Sweetpotato Caterpillars—See **Southern Armyworm, Striped Armyworm.**

Ugly-nest Caterpillar (*Archips cerasivorana*), or **Cherry-tree Tortrix**—This leaf roller is an eastern pest but is also present in part of the West. It is abundant only at long intervals, mostly on chokecherry, but sometimes on cultivated cherry and rarely on apple. The larvae are yellow or blackish and tie twigs and leaves together, making a large nest. The moths are yellow marked with brown spots and blue bands and have a 1-inch wingspread.

Variable Oak-leaf Caterpillar (*Heterocampa manteo*)—Distributed from New England to Texas, but more destructive in the South. The caterpillar, which has variable markings on a greenish-yellow background, devours leaves of oak, especially white oak, basswood, walnut, black birch, hawthorn, and persimmon. The moth is pale ash-gray with 3 wavy dark lines crossing the fore wings.

Velvetbean Caterpillar (*Anticarsia gemmatilis*)—Found only in the Gulf states on soybeans, velvetbeans, cowpeas, peanuts, also on kudzu vine and young tips of black locust. Soybeans are usually defoliated first. The caterpillars vary from dull-green to olive-brown or black, with white lines running the length of the body. The nocturnal moths are buff to dark brown or black, with a white diagonal line across the wings.

There is a rather efficient egg parasite and a fungus which attacks the worms. Recent experiments with DDT sound promising for control.

Walnut Caterpillar (*Datana integerrima*)—A native moth found from Maine to Florida and west to Kansas or farther. It may be a serious pest of beech, oak, willow, honey locust, and thorn trees. The caterpillars are 2 inches long, dull black, reddish when young, covered with long white hairs. The moths are dark buff with 4 brown transverse lines on the fore wings.

The eggs are laid in masses on the underside of leaves and the larvae feed in colonies, crawling to the tree trunk en masse to molt, then going back to feed again. Pupation is in the soil. There are two generations in the South, one in the North.

The caterpillar groups can be destroyed, or the trees sprayed with lead arsenate.

Western Tent Caterpillar (*Malacosoma pluvialis*)—A common species in the Pacific Northwest. The larvae are tawny with blue and orange spots.

They live in small compact nests and feed on alder, apple, hawthorn, wild and cultivated cherry, currant, and rose.

Yellow-necked Caterpillar (*Datana ministra*)—Distributed throughout the country. Primarily a pest of fruit trees—apple, apricot, blackberry, cherry, peach, pear, plum, quince; also feeds on beech, birch, hazel, hickory, linden, oak, walnut, and other ornamental trees and shrubs. The caterpillar is 2 inches long, with black head, orange-yellow thorax (the yellow neck), black body with 4 yellow stripes along each side, and is covered with fine long white hairs. The larvae work in groups and when disturbed their heads and tails are thrown into the air. Young larvae skeletonize leaves, older larvae eat all but stem and midrib. The moths have brown fore wings, 1½-inch wingspread. Pupation is in the soil and there is one generation a year, with chief injury in July and August.

Control. Shake caterpillars off small trees and crush them. Spray larger trees with lead arsenate when larvae are young.

Yellow Woolly Bear, or **Virginia Tiger Moth** (*Diacrisia virginica*)—The caterpillars are very hairy, yellow, or straw-colored with black lines. They are general feeders and may injure many vegetables and flowers, including asparagus, bean, beet, blackberry, cabbage, canna, carrot, cauliflower, celery, cherry, corn, currant, dahlia, eggplant, gooseberry, grape, hollyhock, lily, melon, morning glory, parsnip, peanut, pea, potato, pumpkin, radish, raspberry, rhubarb, Spanish needle, squash, sunflower, sweet potato, turnip.

The moths have white wings with black spots and a yellow-brown, black-spotted abdomen. There are two broods. Pupae winter inside hairy cocoons.

Spray or dust with lead arsenate or cryolite.

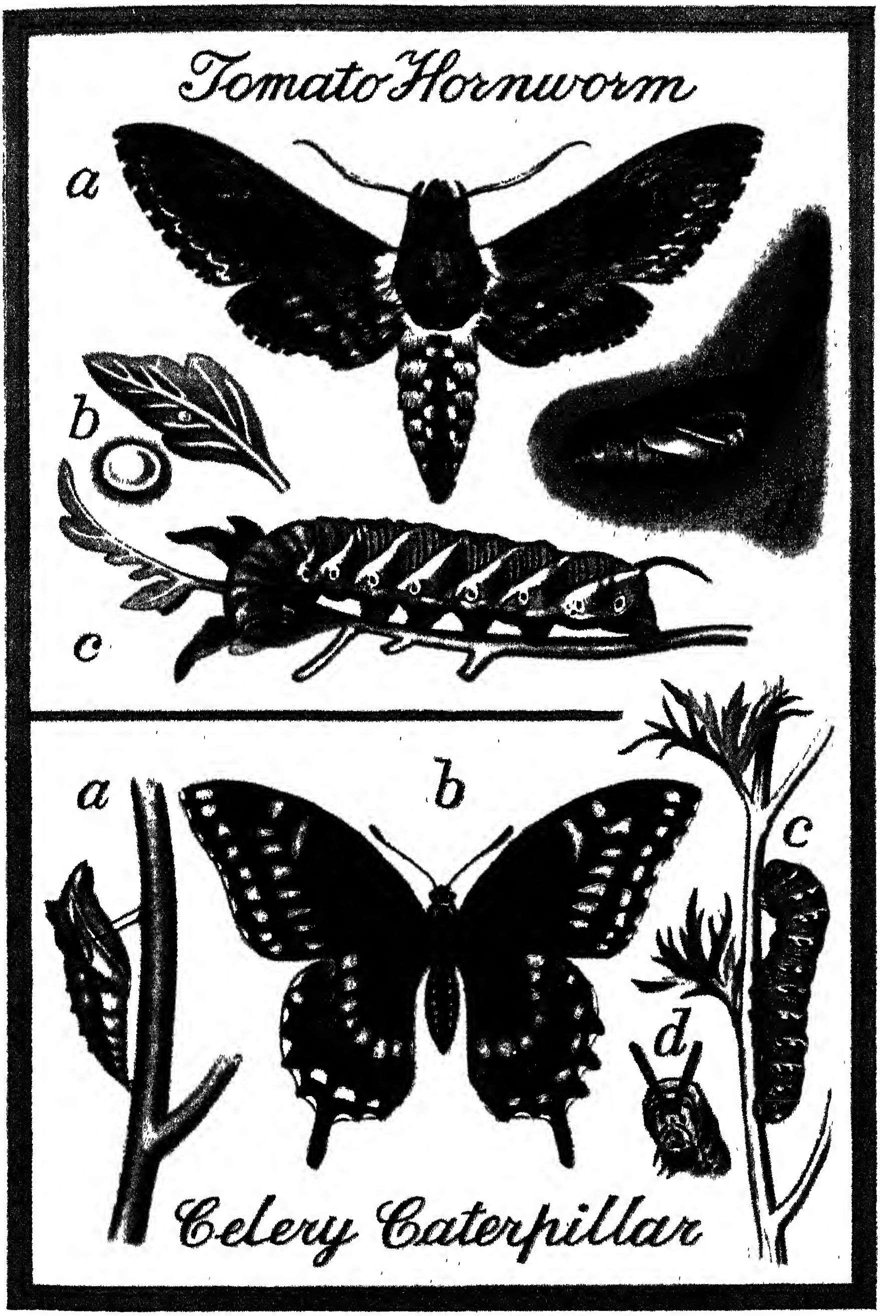
Zebra Caterpillar (*Ceramica picta*)—Occurring throughout the country, feeding generally on truck, cereal, fruit crops, on forest and ornamental trees. This is a velvety-black cutworm with prominent yellow stripes, most injurious to fall garden crops. The moth is rusty brown.

Arsenical sprays or dusts will give control when larvae are young.

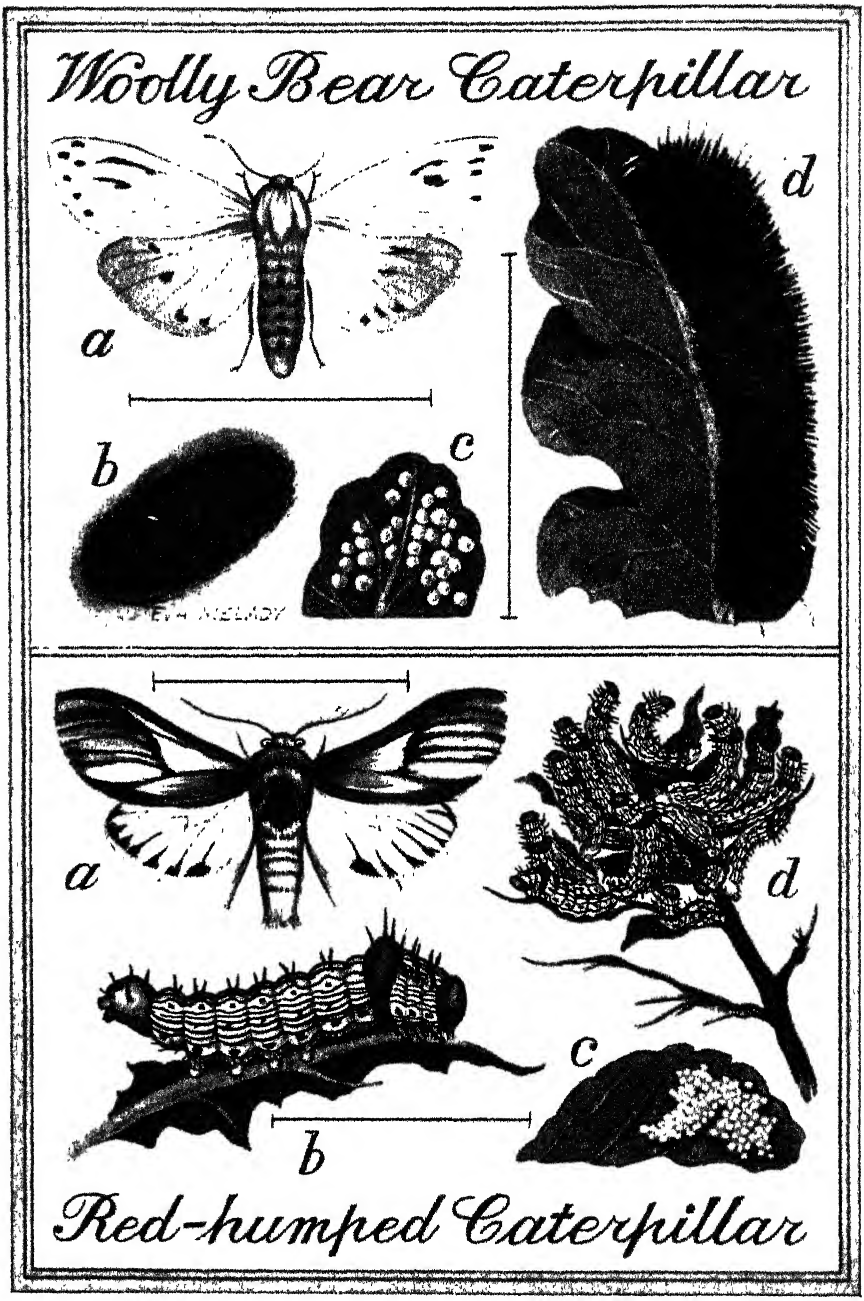
CATS—See under **Mammals.**

CENTIPEDES

Centipedes are flattened, many-segmented, long-bodied animals with moderately long antennae, 1 pair of legs to a body segment (thereby differing from millipedes, which have 2 pairs per segment), and 4 pairs of jaws, 1 pair of which is modified into poison fangs. They are usually swift runners, are found in soil or under logs or stones, and are predaceous



XIX **TOMATO HORNWORM** (See TOBACCO HORNWORM): **(a)** adult moth, natural size; **(b)** egg on leaflet and egg (enlarged); **(c)** larva with "horn"; **(d)** pupa in soil. **CELERY CATERPILLAR** (See BLACK SWALLOWTAIL): **(a)** pupa or chrysalid; **(b)** male swallowtail butterfly; **(c)** full-grown caterpillar feeding on celery; **(d)** front view of larva showing forked horn.



XX **WOOLLY BEAR CATERPILLAR** (See BANDED WOOLLY BEAR): **(a)** adult moth; **(b)** pupa in hairy cocoon; **(c)** eggs on leaf (enlarged); **(d)** hairy hedgehog or bear caterpillar (somewhat enlarged). **RED-HUMPED CATERPILLAR: (a)** adult moth; **(b)** caterpillar with red head and hump; **(c)** eggs; **(d)** larvae in typical position.

on earthworms, snails, and some insects. Their bite is painful to human beings but is not often serious. There are many species which are probably to be considered more beneficial than harmful. True centipedes are not garden pests.

The Garden Centipede (*Scutigerella immaculata*)—Called a centipede only because it looks something like one. Actually it is a symphylid, belonging to the class Symphyla, the members of which are distinguished from true centipedes by having only 12 pairs of legs in the adult form and fewer when young (Figure 58) by a maximum of 3 pairs of jaws and no poison fangs, and having no eyes. They live in damp places rich in organic matter, in leafmold, manure piles, or peaty soils.

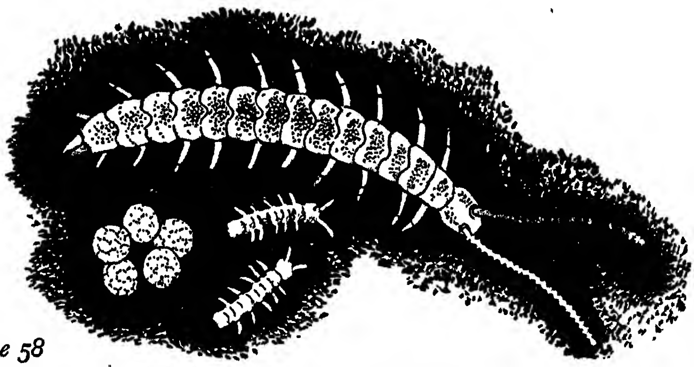


Figure 58
Garden centipede or Symphylid, showing adult, young, and eggs

The garden centipede is small, ¼ inch long, pure white, and very active. It has well-developed antennae kept constantly moving and travels through the soil in cracks, crevices, and tunnels left by decaying plant roots.

This pest is found in soil in gardens and greenhouses in many parts of the country, but seems to be particularly injurious in California in the peaty soils where canning asparagus is grown. The centipedes perforate young shoots with their burrows and sometimes girdle seed-bearing shoots in midsummer. They injure sugar beets and lettuce, radish, tomato, cucumber, and other vegetables, are very destructive to greenhouse snapdragon and also to sweet pea, aster, and other flowers.

Small white eggs are laid in clusters of 5 to 20 about a foot deep in soil, any time between April and September, with the minute young hatching 7 to 10 days later. At first they have only 6 pairs of legs, 10 body segments, and very short antennae, but they add another pair of legs and lengthen antennae at each molt. When greenhouse soil is wet down and crops are started in fall the symphylids begin feeding on plant roots; in outdoor gardens they are active in spring.

Control. The garden centipede is controlled in canning asparagus fields by flooding them for several days in winter or in summer. Soil in small garden beds or in greenhouses can be treated before planting with carbon bisulfide, using 2 ounces each in holes 18 inches apart in staggered rows.

CICADAS

The cicadas (family Cicadidae) are sometimes erroneously called locusts. They are members of a large family—1,500 species in the world, 75 or more in North America—but in common usage we distinguish only 2 species, the periodical cicada or seventeen-year-locust, and the annual or dogday cicada. They are sucking insects, have front wings of the same texture throughout, and hold their wings in a roof-like position. They are noted chiefly for their shrill noises or "singing" produced by special vibratory organs under the base of the abdomen of the male.

Dogday Cicada (*Tibicen linnei* and other spp.)—Also called **Harvestman**, or **Annual Cicada**, even though it is supposed to have a two-year cycle. The adults are larger than the periodical cicada, have a black body with a whitish bloom and green margin to the wings, and numerous lighter markings on thorax and abdomen. They are around on summer dogdays, in July and August, and do not cause injury enough to worry about. The cicada-killer or digger wasp gets rid of some.

Periodical Cicada (*Magicicada septendecim*)—A native of North America, named for its regular occurrence at long intervals. There are two races, one appearing every thirteen years and southern in its range, the limits given by Metcalf and Flint being Virginia, southern Iowa, and Oklahoma on the north and west, and the Atlantic coast and Gulf of Mexico for the other two boundaries. The other race, commonly known as the seventeen-year locust, has a seventeen-year cycle, and ranges from Massachusetts, Vermont, Michigan, and Wisconsin to Kansas, Texas, northern Alabama, and northern Georgia. Both races are more abundant east of the Mississippi River. Each race has a number of broods, which appear in different years, so that while each brood has a thirteen-year or seventeen-year cycle it may not be that many years between cicada swarms in any given locality. These broods are numbered, and it is possible to predict accurately which one will be appearing when. It was brood II which was widespread over the eastern seaboard in 1945, the first time it had been seen since 1928, and can be expected next in 1962. But brood VI will be present in some areas in 1949, brood X in 1953, and brood XIV in 1957. The important appearances of the thirteen-year race are broods XIX in 1946 and XXIII due in 1950.

The adult periodical cicada has a stout black body about an inch long with wings extending well behind the body when at rest. It has reddish-orange eyes, legs, and wing veins. It appears in late May or early June and is around for 5 or 6 weeks. One town may have cicadas in such abundance that life is made hideous with their shrill, unending song, and automobilists driving through stop their cars to see what is the matter with their engines. In some gardens in that town tree trunks will be covered with the cast shells of the nymphs, and the ground under trees literally perforated with holes about a half-inch across. The next town, only a mile or two away, may be lucky and have almost no cicadas.

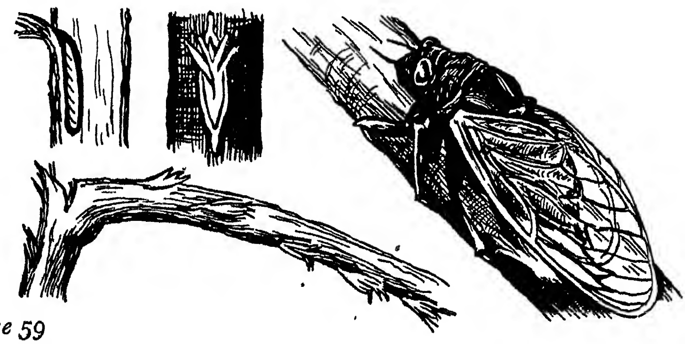


Figure 59

Periodical cicada, "seventeen-year locust," laying eggs, and twigs showing bark torn in process

The female has a tough, horny ovipositor, and the chief damage of the insect is the tearing of twigs as eggs are deposited in rows, the bark being pushed away and the wood raised into bundles of splinters. (Figure 59.) Some 75 trees, shrubs, and even herbaceous plants are used for egg-laying, but oak is preferred, with hickory and apple perhaps next. Dogwood twigs are often injured. Twigs and small branches so punctured usually turn brown but hang on as an eyesore for some weeks or even months before falling to the ground. The eggs hatch in 6 or 7 weeks, the nymphs drop to the ground and burrow to the roots, where they stay 6 and 18 inches below ground level and feed until the seventeenth spring. Then they burrow upward and crawl out when ready for the final molt. Sometimes, in moist places, they construct earthen cones or chimneys before coming out. They crawl to a tree trunk, stick, or other object, the thorax is split, and the winged cicada crawls out, leaving the hard, empty shell in life-like position behind. Twenty to forty thousand individuals may emerge from the ground under one large tree.

Control. Since the chief injury is to young fruit and ornamental trees it would not pay to plant nursery trees the year a large cicada brood is

due in a given locality. Also, avoid pruning young trees heavily the year before a brood is due, and cut off weakened twigs as soon as the season is over. Very valuable young trees can be covered with mosquito netting while adult cicadas are laying eggs. Skunks are of some help in digging into the ground to eat the nymphs, but their damage to the lawn is often greater than possible cicada injury to trees.

CORN EARWORM

Corn Earworm (*Heliothis armigera*)—Present practically everywhere in the world between the parallels of 50° north and south latitudes. Taking the United States as a whole it may be the most important corn pest, and it is injurious to other crops under other names—Tomato Fruitworm, Tobacco Budworm, Cotton Bollworm. The claim has been made that American farmers grow two million acres of corn a year just to feed the corn earworm.

The caterpillars, larvae of moths (family Noctuidae), are nearly 2 inches long when full-grown, yellowish or green or brown with lengthwise light and dark stripes. They work chiefly on the corn ear, but sometimes attack tassels and leaves. The tip of the ear is eaten down to the cob, with masses of moist castings showing at the end. In some years nearly 100 per cent of field corn is attacked. Late-season sweet corn may also be almost entirely infested. The larvae cut off the silk, preventing pollination (resulting in nubbins), and by their feeding they carry various mold fungi into the kernels. (Plate XIII, page 150.)

As the tomato fruitworm, the larva begins feeding on foliage but soon works into green fruit, usually burrowing in at the stem end and sometimes destroying as much as 25 per cent of the tomatoes. They are restless caterpillars, moving from one fruit to another and over onto beans, cabbage, broccoli, and lettuce. As the cotton bollworm it injures green bolls of cotton, and as the tobacco budworm it works in tobacco buds.

The list of food plants also includes alfalfa and clovers, globe artichoke, chick pea, geranium, gladiolus, grape, mignonette, okra, peach, pea, peanut, pear, pepper, pumpkin, rose, squash, strawberry, sunflower, hairy vetch.

The corn earworm winters as a pupa 2 to 6 inches below ground and the moths crawl out through exit holes prepared by the larvae. The adults vary in color, the front wings grayish-brown marked with dark lines shading to olive-green, the hind wings white with dark spots or markings; wingspread 1½ inches. They fly at dusk or on warm, cloudy days, feed on nectar of flowers, and lay 500 to 3,000 eggs, yellowish, hemispherical,

ridged, singly on host plants. There are two or three generations a season. Moths of later generations often lay their eggs on corn silk, the larvae feeding on leaves or directly on the silk and then down into kernels at the tip of the ear. Infestations in the North probably come from adults which have migrated from the South.

Control. Sweet corn is protected by injecting ¼ teaspoon mineral oil, usually combined with pyrethrum or dichlorethyl ether, into the tip of each ear about 5 days after the silks first appear or when they start to wilt and darken. Too early application of oil interferes with fertilization and development of kernels, while treatment too late will not control the earworms. Proprietary oil preparations in special applicators are available at many seed stores, or the oil may be administered from a machine-oil can. Some gardeners prefer the old-time farmer's method of tying stout twine tightly around each ear an inch or more from the tip.

On tomatoes, fruitworms can be controlled by applying pinches of bait, 1 part cryolite to 9 parts corn meal or cottonseed meal, to the fruit clusters. Cryolite can also be used on young broccoli and cabbage, but not after heading starts. Commercial growers get control on broccoli by dusting with calcium arsenate, but in such cases the vegetables should be thoroughly washed by machinery. Such a poison should not be used on edible plant parts in the home garden.

There are a great many insect parasites of the corn earworm, and birds are credited with eating them in quantity. In my own garden, however, when the birds come in after earworms it means good-by to any hope of sweet corn left for myself.

CRAYFISH

Crayfish, or crawfish, are members of the animal class Crustacea, which also includes lobsters, crabs, and sowbugs. Crayfish are almost miniature lobsters, having the same horny shell, head and thorax united into one unjointed portion, and the hind portion, the abdomen, jointed and flexible. They have 2 big grasping pincers or claws and, behind these, 4 pairs of walking legs. They are green to brown, 3 to 6 inches long, and molt frequently and periodically since the hard shell cannot grow.

In the fall the female curls up her tail to form a basket and carries her eggs there until the next summer. It seems strange to find such aquatic creatures as garden pests, but they live in burrows in wet soil. In places like New Orleans, where the soil surface is close to the water table, lawns are often dotted with crayfish mounds—round piles of mud 3 or 4 inches high, opening at the top like chimneys. The crayfish crawl

out of the burrows at night to eat cotton and other plants as well as dead or alive animal food.

Control. Use 2½ tablespoons coal-tar creosote emulsion to 1 gallon of water and pour ½ cup in each crayfish hole, or place 2 tablespoons carbon bisulfide (very inflammable) in each hole and cover with soil.

CRICKETS

Crickets belong to the insect family Gryllidae and are close relatives of the long-horned grasshoppers. They are noted for the chirping notes produced by the males when they rub together specially modified parts of the fore wings. They have long, filiform antennae, a spear-shaped ovipositor, and 3-segmented tarsi. The hardened horny fore wings are called tegmina; they are flat on the back, but bent down abruptly along the sides. According to their habitats they are known as mole crickets, (burrowers in ground), bush crickets, tree crickets, ant-loving crickets, and field crickets. They are nocturnal insects.

Black-horned Tree Cricket (*Oecanthus nigricornis nigricornis*)—Widely distributed. This cricket varies from pale green to black, inhabits tall plants and bushes along streams and other damp places, and lays its eggs in rows in pithy stems of raspberry, blackberry, loganberry, grape, elder, and sometimes woody twigs of elm, maple, peach, apple, and other trees.

Camel Cricket (*Daihinia brevipes*)—Found in the Great Plains states from North Dakota to northern Texas. It feeds at night, is found mostly in sandy places, injures tomato, watermelon, cotton, cowpeas, and other plants in the seedling stage. Poison bran mash bait gives satisfactory control.

Coulee Cricket (*Peranabrus scabricollis*)—More nearly related to the katydids than true crickets; very destructive in Montana and Washington. It feeds particularly on sagebrush as well as dung and living and dead animals, but it may infest nearly all field and garden crops, fruits, or shrubs. The adults are fat, soft-bodied, 1½ inches long, dark reddish-brown, wingless in the female form, and with short winged stubs in the male. They are active during the daytime, in the sun, and move in migratory hordes, devastating everything in their path. See Mormon Cricket for control.

Field Cricket (*Gryllus assimilis*)—Present everywhere in small numbers, sometimes seriously abundant. These black or brown crickets are indiscriminate feeders, eating plants in the garden, or paper, food, linen, or clothing in the house. In California and the Gulf states they injure

seedling cotton and cereals, damage fruits of tomato, all cucurbits, peas, beans, strawberries. In the North they hibernate in the egg stage, with one generation a year, but in warm climates they usually winter as nymphs with as many as three generations a year. During the day they remain under trash, coming out in late afternoon to chirp, feed, mate, and the females to lay banana-shaped eggs in damp soil.

Control. Use poison bran bait as for grasshoppers; spade or plow deeply in fall to bury eggs, maintain a fine dust mulch to kill or drive away active stages.

Four-spotted Tree Cricket (*Oecanthus nigricornis quadripunctatus*) —Like the black-horned tree cricket except for 2 dark spots on 2 basal antennae segments.

Jerusalem Cricket (*Stenopelmatus fuscus*), or **Sand Cricket**—A western species. This cricket is of little importance in the garden except to potato tubers in newly broken soil. It is a large, wingless, amber-brown form which makes queer snake-like tracks in dusty roads.

Mole Crickets—Northern Mole Cricket (*Gryllotalpa hexadactyla*), a native pest, generally distributed but serious only in very moist soils as a pest of potatoes and root crops; **Southern Mole Cricket** (*Scapteriscus acletus*), a southern native; **Changa** or **Puerto Rican** or **West Indian Mole Cricket** (*Scapteriscus vicinus*), an introduced species similar to the native. (Plate XXI, page 214.)

All mole crickets are flat like other crickets but their front legs are greatly enlarged for burrowing like moles. They are dark brown, up to 1½ inches long, covered with velvety hairs. They live deep in the ground during the day, coming out at night to pulverize a garden bed and the plants growing in it. Most injury comes from burrows like mole tunnels, but smaller, in the upper inch or two of soil. The crickets also eat pits into underground roots and stems, cut off stems above ground, and eat seed.

Control. There are many suggestions: sulfur placed in the seed drill as a deterrent; a gauze floor to seedbeds made of galvanized or copper wire mosquito netting coming up at the side of the bed and projecting 2 inches above ground; setting out plants inside cylinders made of bottomless tin cans or tarred paper; poisoning with carbon bisulfide by punching holes in moist ground with a cane and pouring in 1 ounce per hole.

In South Carolina a poison bait is recommended with the following formula:

5 lbs. dry bran or corn meal
5 lbs. cottonseed meal
½ lb. calcium arsenate
2 quarts of a solution of 1 part molasses mixed with 9 parts water.

The dry materials are mixed together with a stick and just moistened with the molasses solution. The bait is scattered lightly in late afternoon, broadcast between the rows.

Other suggestions are to substitute a commercial poultry egg mash containing dried milk for the bran in poison baits, or to fumigate seedbeds with 1 pound crude naphthalene flakes per 100 square feet.

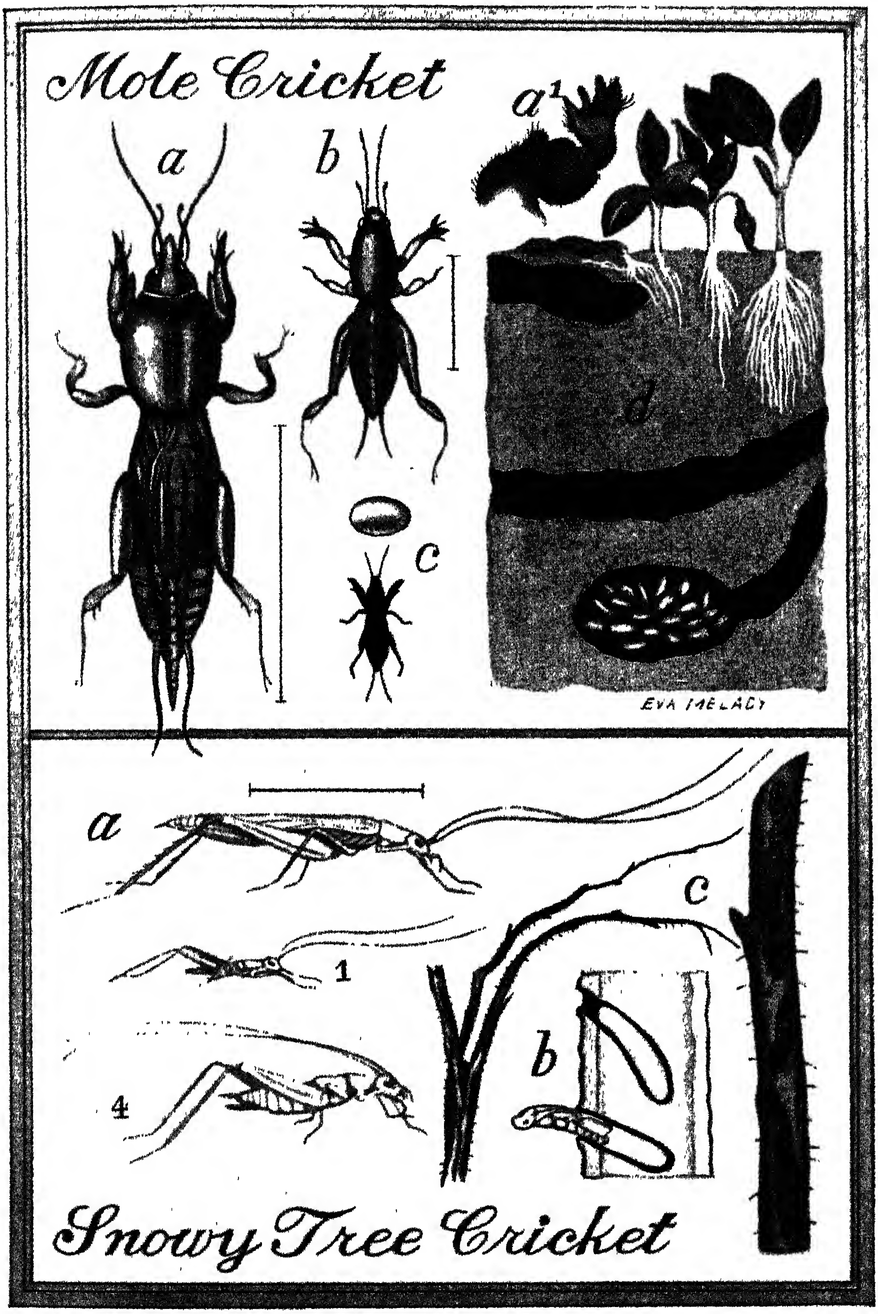
Mormon Cricket (*Anabrus simplex*), also called **Western, Great Plains, Idaho,** or **Black Cricket**—This is a very destructive species which has periodical migrations from native breeding grounds in the hills to devastate garden crops, fruit, legumes, and grain in the milk stage. It prefers succulent vegetables but will eat sagebrush and other bushes, and also other insects and dead animals. It is found in most of the area west of the Rocky Mountains. In Utah there is a monument to the great flocks of seagulls which ended a very serious outbreak of Mormon crickets in 1848.

The winter is spent in the egg stage in barren soil in sunny locations. The eggs hatch on the first warm days from February to April. It takes 75 to 100 days to pass through the 7 nymphal stages, but the adult form is around in June and July with egg-laying continued all summer. This cricket is active during the day, rests at night, the male singing in the morning up to about ten o'clock.

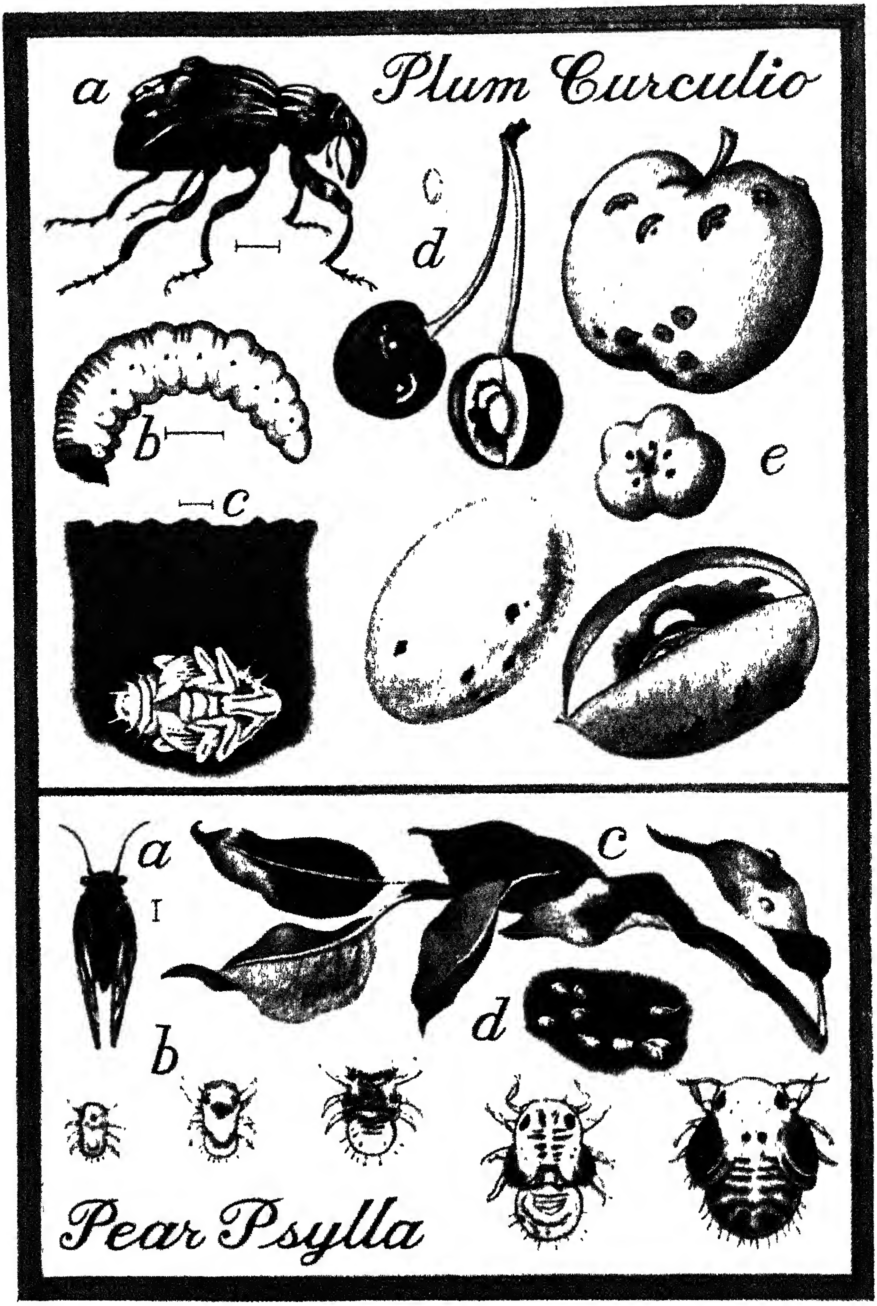
Control. Since the Mormon cricket cannot fly, barriers of 10-inch strips of sheet metal or 8-inch boards with the upper 4 inches covered with metal or oilcloth, set on edge, will keep migrating hordes out of the garden. Sodium or calcium-arsenite dusts, using 1 part arsenite to 3 parts hydrated lime, applied directly on the migrating crickets, is said to give a good kill. Poison baits are not very effective.

Snowy Tree Cricket (*Oecanthus niveus*)—Widely distributed throughout North America. Tree crickets are generally beneficial, eating aphids, treehoppers, and scales, but they do feed somewhat on flowers, fruits, and leaves; and twigs may be broken by egg punctures. The snowy tree cricket is pale green, with a slender body, 5/8 inch long, and a black spot on the first 2 antennal segments. (Plate XXI, page 214.) It lays eggs singly in a row down one side of a twig or cane of apple, ash, blackberry, cherry, loganberry, pear, plum, prune, peach, and other fruits and ornamentals. Egg-laying is in fall; there is only one generation a year. The songs of the males are short, clear, whistling notes.

Control. Spray or dust fruits with arsenicals in early summer. Prune out and burn egg-bearing parts of canes before spring.



XXI **NORTHERN MOLE CRICKET:** **(a)** adult (somewhat enlarged); **(a1)** detail of front leg showing adaptation for digging; **(b)** nymph; **(c)** egg (magnified) and first nymphal stage; **(d)** injury to seedlings by burrowing, and eggs in pocket in soil. **SNOWY TREE CRICKET:** **(a)** adult; **(a1)** first instar; **(a4)** fourth instar, nymph with wing pads; **(b)** egg in position in wood and hatching nymph (much enlarged); **(c)** egg punctures in a row along stem.



XXII **PLUM CURCULIO:** **(a)** adult snout beetle; **(b)** grub (larva); **(c)** pupa in soil; **(d)** egg; **(e)** typical injury, crescent-shaped scar, to cherry, apple, plum. **PEAR PSYLLA:** **(a)** adult; **(b)** nymph in different instars; **(c)** injury to pear leaves; **(d)** eggs attached to bark by one end.

CURCULIOS

Curculios (family Curculionidae) are snout beetles and are recognized by the way the head is prolonged forward and downward with biting mouth parts at the end. Only those curculios which commonly go under that name are considered here. Other curculios are to be found under BORERS and under WEEVILS. This is a very large family of beetles with more than 2,000 species in North America, and they all eat plants, both as larvae and as adults.

Apple Curculio (*Tachypterellus quadrigibbus*)—A native insect found from Canada to Florida and west to the Mississippi River. Preferred hosts are apple, haw, wild crab, quince, pear, and shadbush. Feeding and egg punctures result in knotty, misshapen, undersized fruit and premature drop. The work of the apple curculio can be told from that of the plum curculio by the larger number of punctures close together through the skin, a larger deadened area of fruit surface, and by the absence of crescent-shaped marks.

The curculio winters as an adult in leaves and rubbish on ground. It is brown with 4 humps on the back and a long, slender snout. Before fruit sets the beetle feeds on buds, fruit spurs, and terminal twigs, blighting young shoots. The fruit is attacked as soon as set, and the females eat cavities in which to lay their eggs. Many of the larvae develop in June drops and many in mummied apples left on the trees. Pupation is inside the apple with new adults emerging from the middle of July to early September to feed until time for hibernation.

There are 2 very closely related curculios on apple. One, called the larger apple curculio, is found from Illinois and Missouri to Nebraska and Texas; the other (*Tachypterellus consors*) goes from the Rocky Mountains to the Pacific coast.

Control. Spraying does not control the apple curculios very well, since the adult beetles feed only slightly on the surface of the fruit. Cleaning up June drops and general orchard sanitation are in order.

Black Walnut Curculio (*Conotrachelus retentus*)—A common pest of young walnuts in eastern United States. The curculio is pale reddish covered with grayish pubescence or hairy growth. Curculios hibernate as adults, feeding on young shoots in spring and making crescent-shaped cuts for their eggs in very young walnuts, which drop to the ground half-grown. Pupation is in soil, with beetles emerging in August and September to feed on leaf petioles before going into hibernation.

Control. Several parasitic wasps and flies attack this curculio. Larvae which are still in dropped nuts can be destroyed by burying deeply or by putting nuts in water.

Butternut Curculio (*Conotrachelus juglandis*), also known as **Walnut Weevil**—Distributed throughout the butternut range, attacking native and Japanese butternuts and young English walnuts. Adult beetles, brownish-gray, resembling plum curculio, but with white markings, ¼ inch long, make punctures in nuts, tender tips, and leaf petioles. Eggs are laid in new growth and in crescent-shaped punctures in young nuts; the grubs, dirty-white with brown heads, burrow through the nut or down the twig. When full-grown, in 4 or 5 weeks, they go below the soil surface to pupate.

Control. Spray new shoots and leaves in early June with a very heavy dose of lead arsenate.

Cabbage Curculio (*Ceutorhynchus rapae*)—An ash-gray weevil, ⅛ inch long, with a short snout. Adults and grubs gouge out stems and adults also work on leaves. They infest seedling cabbage and cauliflower, horseradish, mustard, radish, turnip, and cruciferous weeds.

Control. Trap crops are helpful in control.

Cherry Curculio (*Tachypterellus consors cerasi*)—Closely related to apple curculio; found on cherry in Colorado and New Mexico.

Clover Root Curculio (*Sitona hispidulus*)—A common pest of clover and alfalfa, but sometimes of interest to gardeners for its feeding on soybeans, cowpeas, and other legumes. Tiny grayish grubs score and furrow roots, often nearly girdling them. Small gray or brown beetles with short, blunt snouts feed on foliage, often eating off tops of young soybeans entirely.

Control. There are no satisfactory control measures except crop rotation.

Cowpea Curculio (*Chalcodermus aeneus*), also known as **Cowpea Pod-weevil**—It is a pest of cowpeas, injures seedling cotton, beans, and strawberries, and is becoming increasingly important. Although most abundant in the cotton states, it has been found as far north as Iowa. The adults lay eggs in cowpeas or beans in the field and larvae feeding in developing seeds destroy them for human or animal food or use as seeds.

Control. Garden plants can be dusted with fluosilicates or calcium arsenate. See Bean Weevil for treatment of stored peas or beans.

Grape Curculio (*Craponius inaequalis*)—A native pest of wild grape, injuring berries of cultivated grapes in some places. It has been reported as injurious from New England, Missouri, Ohio, Kentucky, West Virginia, and Florida. The beetle is very small, just over $\frac{1}{10}$ inch long, black, winters in sheltered locations and feeds for a month or two in spring before laying eggs in cavities under skin of grape berries. The footless larvae feed on berry flesh and seeds, then drop to the ground and pupate by midsummer, with adults emerging and feeding for a while before hibernation.

Special control measures are considered unnecessary.

Hickory-nut Curculio (*Conotrachelus affinis*)—Confined to various hickories, pignut preferred, then shagbark, whiteheart, and butternut. It has been reported from such widely separated states as New Jersey, Ohio, West Virginia, District of Columbia, Florida, Louisiana. The beetle is reddish-brown with a broad band of lighter gray across the back. The adults appear when hickory nuts are half formed to lay eggs in circular cavities in nuts and shells. The nuts drop in midsummer; the larvae stay inside for about a month, then enter the soil to pupate.

Control. Spraying in early spring with lead arsenate helps to control beetles feeding on young foliage. In summer bury dropped nuts deeply, or put them in water. There are several insect parasites.

Plum Curculio (*Conotrachelus nenuphar*)—A native insect found east of the Rocky Mountains. It attacks not only stone fruits—plum, peach, cherry, apricot, prune, nectarine—but is next to the codling moth in importance on apple, and may appear on pear and quince. The adult is dark brown with a grayish patch on the back, 4 definite humps on the wing covers, and a long, curved snout which projects forward and downward in an arc one third the length of the body, which is about ¼ inch long. (Plate XXII, page 215.) It winters in stone walls, hedgerows, or other protected places, appearing on the trees at blossom time. The beetles feed on leaves and petals, injure young fruits by their feeding and egg-laying in small circular excavations marked also by a crescent-shaped slot underneath. Apples are often hard, knotty, misshapen. Even when the larvae do not develop the scars remain to deform the fruit.

The eggs hatch in about a week into gray-white legless grubs with brown heads and curved bodies. They feed in the flesh for 2 weeks or more, by which time the fruit, except cherries, has probably fallen to the ground. The larvae then leave the fruit and go into the soil an inch or two to pupate. On emergence the beetles in the new brood feed on apples, making holes through the skin and eating cavities in the flesh before seeking winter quarters. There is one generation in the North, sometimes two in Virginia and southward.

Control. Two lead-arsenate sprays, properly timed, will usually control plum curculio. The first is at petal fall and the second, most important, about 10 days later, when the shucks are falling from young fruits. These sprays form part of the regular fruit-spray series, the exact composition varying with the location and with the fruit, peaches requiring more caution than apples, and a lead-arsenate oil dust said to be safer than a spray. In some sections cryolite is recommended in place of lead arsenate, but not usually for peaches. In badly infested areas it may be necessary in early morning to jar the beetles from the trees onto sheets placed on the

ground. It is always advantageous to pick up dropped fruits and to destroy them by deep burial or soaking in waste oil, and to clean up possible winter shelters where beetles may hibernate around the orchard.

There are several parasites of the plum curculio, and a fungus also helps in natural control.

Quince Curculio (*Conotrachelus crataegi*)—The most serious enemy of this host. This curculio resembles the plum curculio but is confined to quince, and winters in soil in the grub state rather than as an adult. Irregular cavities are eaten in the flesh of the quince, with a small opening through the skin. White legless grubs feed on fruit during summer but seldom cause it to drop. In fact, the grubs leave the fruit before it drops, so that picking up fallen quinces is no help in control. The beetle is broad, grayish-brown, without humps on the back, and produces the same type of knotty deformed fruit as the plum curculio.

Control by spraying with lead arsenate and lime.

Rhubarb Curculio (*Lixus concavus*)—Common in the East. This is one of the largest snout beetles, ½ inch long, blackish in background, but covered with a rusty powder. It punctures rhubarb stalks and lays eggs in them, but the larvae develop in common curled dock and feed there. The adults do a negligible amount of feeding on rhubarb foliage.

This curculio is not serious enough for special-control measures.

Rose Curculio (*Rhynchites bicolor*), also called **Rose Snout Beetle**—The eastern form is red with a black undersurface and a black curved beak, about ¼ inch long. The western types vary in color, some black and red, some black with a greenish luster; but they all drill holes in buds of wild and cultivated roses for feeding, petals showing many small perforations as the flowers open. Eggs are laid in rose hips and the small white larvae develop there, but drop to the ground for pupation and hibernation.

Control is usually limited to picking off infested buds, but spraying with lead arsenate or dusting with 5 per cent nicotine dust has been successful.

CUTWORMS

High in the ranks of gardening headaches are the cutworms, smooth, fat, soft, repulsive caterpillars—the larvae of night-flying moths (family Noctuidae). Different species occur all over the world and injure almost all crops, but they vary in number from year to year.

The solitary or surface cutworms, including black, bronzed, clay-backed, and dingy varieties, are most likely to harass the home gardener, since they eat the succulent stems of tomato, bean, cabbage, a few other vegetables, and some flowers soon after the plants are set out. They work at

ground level, or just above or below, cutting off the seedling so that it falls over and wilts, for they prefer wilted to fresh greens. (Plate XXIII, page 230.) Climbing cutworms go up the stems of herbaceous plants, shrubs, and vines, sometimes even climbing trees to eat buds, leaves, and fruit.

In the third category are the army cutworms, which work in large groups, consuming all vegetation in one area before crawling en masse to the next field. These are not so prevalent in eastern gardens as in the West, where they are especially destructive to wheat.

Pale western and glassy cutworms are important members of the fourth group—subterranean forms which remain continuously in the soil, feeding on roots and underground stems.

Most surface cutworms have similar habits. They winter as partly grown larvae in cells in the soil, under trash, or in clumps of grass. They start feeding in the spring, working only at night and remaining coiled up in a ball just under the earth surface during the day. When full-grown they dig down several inches in the soil to make a cell where they pupate from 1 to 8 weeks, or over winter. Southern species may have several generations a year, but most northern species have but one, with the moths appearing in summer.

Army Cutworm (*Chorizagrotis auxiliaris*)—A western species reported from Nebraska and generally present from the Rocky Mountains to the Pacific. The full-grown caterpillars are dark, with a pale broad line down the back, a dark stripe on each side, 1¾ to 2 inches long. They appear in armies and attack all kinds of vegetation.

Black Cutworm (*Agrotis ypsilon*)—A surface cutworm also known as the greasy cutworm. This species is gray to brown to nearly black with a broken yellow line on the back and a pale line on each side, the whole appearance being shiny and greasy. The skin has convex, rounded, isolated granules, both large and small. The black cutworm is generally distributed throughout the country and is especially fond of truck crops, often cutting off tomatoes in home gardens. It is a restless feeder, cutting off many plants to satisfy its appetite. It lays eggs singly or a few together on leaves and stems, often on plants in new land. It winters as a pupa. The moths are reddish to brownish-gray with silvery patches at bases and tips of fore wings. There are two generations in the North, often four in the South.

Bronzed Cutworm (*Nephelodes emmedonia*)—A northern species injurious chiefly to corn, grains, and grasses. The larva is dark bronzy brown, striped from head to tail with 5 clear pale lines about half as large as the brown area between, with a granulate skin. There is one generation a year, with the winter spent as a partly grown larva.

Dark-sided Cutworm (*Euxoa messoria*)—A common species that may climb to feed on tree foliage in spring. The larvae are dull, pale green; they attack cultivated crops, wild grasses, and weeds. The moth is silver-gray with dark mottled fore wings.

Dingy Cutworm (*Feltia subgothica*)—A northern species sometimes assuming climbing habit. The larvae are dull, dingy brown with a broad buff-gray stripe down the back divided into triangular areas on each segment, margined with a narrow dark stripe on each side, and with coarse skin granules.

Glassy Cutworm (*Crymodes devastator*)—Widespread, except in more southern states. It is a subterranean species preferring sod, and most injurious to crops following sod. The body of the larva is greenish-white like a grubworm, somewhat translucent or glassy in appearance, and with a red head. The skin is not granulated.

Pale Western Cutworm (*Agrotis orthogonia*)—A subterranean form of great economic importance in the West, where it has destroyed millions of dollars' worth of small grains, beets, and alfalfa. The body is greenish-gray, unmarked by lines or stripes, with a brown head and flat pavement-like granules on the skin. The moth is mottled gray, both nocturnal and diurnal; it appears in late August and September to lay whitish eggs in small batches just under the surface in soft soil. They hatch in a few days and winter as immature larvae, or hatch in the spring. There is one generation a year.

They feed day and night, working on plants just below the soil surface and adding cabbage, carrots, and onions to the cereal and beet hosts.

Red-backed Cutworm (*Euxoa ochrogaster*)—Regularly destructive in many northern sections of the country. The larvae are reddish on the back, feed on succulent plants, and are often very destructive to cereal, forage, and truck crops. Feeding is both above ground and below the surface. Hibernation is in the egg stage in soil.

Control. This species readily succumbs to poison bran mash bait.

Spotted Cutworm (*Amathes c-nigrum*)—Generally distributed throughout North America, but rather scarce in the South. This surface feeder seems to prefer garden crops. It winters as large larvae which bear elongate, wedge-shaped black dashes on each segment, have a dark line through the spiracles, and a smooth skin. Eggs are laid singly or in patches of 100 or more on leaves. There are two or three generations a year.

Variegated Cutworm (*Peridroma margaritosa*)—Very common. This is probably the most widely known and important cutworm, present in many countries and in the United States, damaging cultivated crops to the tune of $2,500,000 or more a year. The larva is ashy or light brown

mottled with dark brown, with a smooth skin, but a distinct yellow dot in the middle of each segment and often a dark W on the eighth abdominal segment. The moth is grayish-brown with dark mottled fore wings and a brassy luster. In early spring it lays small, white-ribbed eggs in large irregular masses on foliage and stems of plants, or limbs of trees, or fences or buildings.

The larvae enjoy garden crops, foliage, buds, and fruits, or trees and vines; they injure flowering plants in garden and greenhouse, and are noted for climbing up carnation stems and eating holes in buds. There are two generations outdoors; more in the greenhouse. Hand-picking, trapping under boards, and poison bait are all used in control.

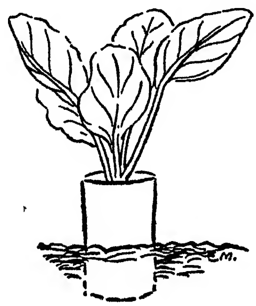


Figure 60

Paper collar around a cabbage seedling—a simple way to foil cutworms

Cutworm Control. In small gardens, surface-feeding cutworms are outwitted by placing stiff paper collars around plants as they are set out. Such collars should project an inch or two into the soil, so that they are held firmly in place and worms working just under the surface are foiled. (Figure 60.) Inexpensive cutworm "protectors," strips of tar paper which lock into a closed collar, are on the market.

For larger gardens, and for climbing cutworms, a poison bait is prepared in the morning and scattered thinly over the area in the evening. There are many variations of the poison bran mash bait, which can be purchased ready mixed or prepared at home.

A popular recipe for poison bait calls for 2½ pounds wheat bran mixed dry with 1 tablespoon of white arsenic, or sodium fluosilicate, or paris green, then moistened and stirred until crumbly with a dilution of 1 cup of molasses or cane syrup in 1 pint of water. The juice and ground rind of an orange or lemon are thought by some to increase the attractiveness of this bait but are not really necessary. Any such mixture is poisonous, dangerous for children, pets, poultry, and birds, but if it is broadcast thinly and evenly there is much less danger in its use.

Some gardeners find a coating of ashes around tomato plants discouraging to cutworms.

Subterranean forms injuring lawns can be killed by grub-proofing with arsenate of lead as described under Japanese beetles. Late fall spading or plowing, exposing larvae and pupae to the rigors of winter, is an aid in eliminating cutworms from sod land to be put into cultivation.

Climbing cutworms are discouraged by poison baits, or by a band of tanglefoot around trees or shrubs, but to avoid injury this should be applied over a band of paper or balsam wool.

DOGS—See under **Mammals.**

EARTHWORMS

Earthworms are friends of man. They are not true insects but belong to the animal phylum Annelida, meaning rings, and are made up of many round segments. They are usually 2 to 10 inches long, having elongate, slender, soft bodies divided into rings, each bearing 8 bristle-like projections known as setae.

Earthworms are hermaphrodites with both ova and sperm cells produced, but they are not self-fertilized, since they mate and store up sperm cells from other individuals until the eggs are laid in a kind of cocoon, a round case or capsule which encircles the body and eventually passes off over the head. The fertilized egg cell divides into cells to form the young worm, which is about an inch long when hatched. There is no larval stage.

Earthworms have been considered by some people the most important of all animals. Charles Darwin estimated that earthworms bring up 7 tons of new soil for every acre of land, that good garden soil normally has about 53,000 worms per acre and poor field soil only half that many. The modern hybrid Soilution worm, produced by Dr. George Sheffield Oliver by crossing the home-loving compost worm with the deep orchard worm, will produce 10 tons of perfect soil per acre if present at the rate of 50,000 individuals per acre.

Earthworms live in moist soil containing decaying organic matter and crawl out at night to feed, or come out when their burrows are filled with water. They eat the soil, and their digestive juices dissolve leafmold and other organic matter, then this digested earth is discharged in the form of castings—composed of soil of the finest quality. Earthworms also drag leaves into their burrows, increasing the organic content of the soil in that way. Strong, healthy worms work from 3 to 8 feet underground, mak-

ing the trip to the surface nightly to deposit castings. Their beneficial action goes much deeper than any man-made spade or plow or rototiller. The Soilution worm planted at the base of young nursery trees is said to make them grow twice as fast as trees planted without a culture of worms, or, put under strawberry plants, will produce 60 quarts of berries from the same plants and space that now give 30 quarts.

Soilution worms are prolific, producing egg capsules every few days. There are several earthworm farms in California, and one I have just read about in Ohio; from these, capsules are sent to gardeners in many states. Earthworm culture seems to make a profitable business for women.

Despite the fact that some gardeners want earthworms in their soil badly enough to support earthworm farms, other gardeners object to lumpy piles of cast earth on their fine front lawns. If you belong to the latter group and insist on killing your worms you may choose between several poisons.

The most virulent poison, and probably the most effective, is bichloride of mercury (corrosive sublimate) at a dilution of 2 to 3 ounces to 50 gallons of water. For small quantities one 7-grain tablet to a quart of water would be about right. It takes around 50 gallons to cover 1,000 square feet of lawn area and the grass should be well watered immediately after the poison is applied. After the worms come to the surface they should be swept up and disposed of so as not to kill birds.

An easier remedy is treating lawns with arsenate of lead, just as for Japanese beetle grubs, but using 5 instead of 10 pounds per 1,000 square feet. Mix 1 pound of the arsenate with a pail of sand or loam and broadcast evenly over an area 10 by 20 feet when the grass is dry. Water the lawn afterward. Another treatment can be made a month later if the worms are not killed.

Mowrah Meal is an old stand-by for earthworms in lawns. It is made from the ground seeds of the madhucca tree of the East Indies and has been available commercially under the name Mowrah Meal. It is comparatively non-poisonous to man, but it deteriorates with age and must be kept dry to remain effective. It is used at 15 pounds per 1,000 square feet.

There are also various devices for electrocuting earthworms in lawns if you persist in trying to get rid of these beneficial creatures.

Earthworms in flower pots really are a nuisance. Lime water is the time-honored remedy, either purchased as such at the drugstore or made at home by stirring 1 pint of freshly slaked lime into 2½ gallons of water and using as soon as it clarifies. Do not put lime water on potted azaleas or any other plants which prefer an acid soil. Tobacco dust may be helpful in such cases.

EARWIGS

Earwigs are beetle-like insects belonging to the order Dermaptera and distinguished from true beetles, of the order Coleoptera, by prominent forceps at the rear of the body and by gradual metamorphosis, young nymphs resembling adults except for size. The mother broods over her eggs in the soil and cares for her young. Earwigs have biting mouth parts and feed on decayed or living plant material and some species of insects. They live on the ground under stones or leaves, or under dead logs. They were named from the mistaken notion that they crawl into the ears of sleeping persons. There is only one species of much consequence to gardeners.

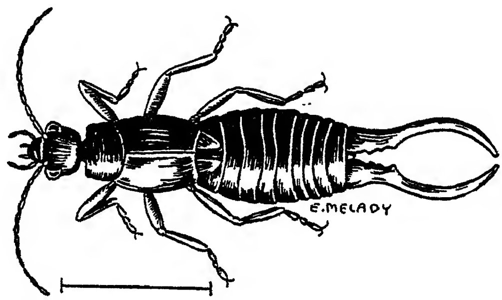


Figure 61

European earwig—large curved forceps denote male

European Earwig (*Forficula auricularia*)—An introduced species found in some parts of North America. In 1911 this earwig was discovered at Newport, Rhode Island, and in 1915 another colony was found at Seattle, Washington. Since then earwigs have been reported from California, Colorado, Idaho, Oregon, Utah, Massachusetts, and New York, and are probably present in other states.

The insect is hard, dark brown, up to 4/5 inch long, and has a pair of sharp pincers or forceps at the tip of the abdomen and protruding about one fourth the length of the body. The front wings or wing covers are short and the hind wings are folded up under them, aided by the forceps. These structures are larger and more curved in the male than in the female. (Figure 61.)

The female lays a batch of eggs in early spring, broods over them until they hatch, then watches over her young until the first molt, after which she leaves them, and often lays another batch of eggs.

Young nymphs feed on green plant shoots, either flowers or vegetables, and later in the season older earwigs work on blossoms, eating stamens and bases of petals. Adults also feed on fruit and vegetables, on larvae of

other insects, and sometimes on dead and dying earwig relatives. They are quite a pest in houses, crawling over everything at night, hiding under cushions, dishes, or clothing, in crevices of various sorts.

Control. Although the harm to garden plants from earwigs has been somewhat overrated, it is sometimes necessary to control them. The standard method is by means of a bait—6 pounds wheat bran mixed with ½ pound sodium fluosilicate and moistened with 1 pint fish oil—scattered thinly over garden beds and about trees and fences. Do not water such areas until the bait has been out at least 2 nights.

FLEA HOPPERS

Flea hoppers are small bugs which look something like aphids and suck sap from leaves in somewhat the same manner. There is only 1 species important to gardeners.

Garden Flea Hopper (*Halticus citri*)—Probably a native insect, found from Maine to Florida and west to Utah. These hoppers with their small size, dark color, and jumping habit resemble flea beetles, but they are really sucking insects, leaving pale areas on foliage where sap has been withdrawn. (Plate VII, page 134.) They attack, sporadically, most vegetables: bean, beet, celery, corn, cowpea, cucumber, eggplant, lettuce, pea, pepper, potato, pumpkin, squash, sweet potato, tomato. They also may injure chrysanthemum, morning glory, asparagus fern, and other ornamentals. They feed on many weeds.

Flea hoppers winter as adults, laying eggs in spring in punctures made in leaves or stems of host plants. The nymphs are greenish when they appear in early spring but turn nearly black as they change to adult hoppers. There are 2 types of females, 1 with long wings, a narrow body, about 1/12 inch long, the other with short wings, an oval body, long legs, about 1/10 inch long. It is the latter type which most closely resembles flea beetles.

Control. Spray plants with nicotine sulfate and soap, or apply 3 per cent nicotine dust as soon as the insects are noticed. Destroy weeds around the garden to remove winter homes.

FLIES

Flies belong to the order Diptera, meaning 2-winged, the order including all insects with 1 pair of wings. The second pair is represented, if at all, only by thread-like knobbed organs called halteres. There are some wingless flies and some with reduced wings, but the halteres are usually

present. Fly mouth parts are adapted either for piercing and sucking or for lapping. There is complete metamorphosis, the adult being entirely different from the immature stage. There are a great many species of flies. Some are particularly dangerous to man as carriers of human diseases such as sleeping sickness and yellow fever, and some are destructive to crops. But some flies are useful scavengers, cleaning up dead animals and plant wastes, and others are insect destroyers—either predators, like the syrphid flies, or parasites, living in or on harmful insects.

Larvae of flies are called maggots. They are footless, grublike creatures, cylindrical, usually soft, white or yellowish, with the head reduced.

Black Cherry Fruitfly (*Rhagoletis fausta*)—Distributed throughout the northern United States on cherry, wild cherry, pear, and plum. Except that the abdomen is entirely black and that it apparently prefers sour to sweet cherries, this species is like the cherry fruitfly, which see.

Black Flies. Sometimes potted house or greenhouse plants have white maggots in the soil and small black flies hovering in the air around the plants. These may be midges which breed in manure, or fungus gnats which breed in decaying vegetable matter. When there is a good deal of humus in the potting soil or plants are fed with organic fertilizer there may be trouble sometimes with white maggots and black flies.

Control. Use less rich soil, or bake it before using for potting, or water plants with nicotine sulfate without soap, or with lime water as for earthworms, or work in tobacco dust.

Carrot Rust Fly (*Psila rosae*)—A European pest first noticed in this country in 1885. It is now present in the northeastern states and also in the Pacific Northwest, where it is quite injurious in gardens in Oregon and western Washington. Carrots are the most important hosts, but there may also be serious injury to parsnip, celery, celeriac, and parsley. The damage is caused by maggots feeding on the root system, producing stunting, dwarfing, or complete destruction of plants, especially in small gardens. Larval excrement looking like iron rust is laid down in the root tunnels, whence the name rust fly. Soft-rot bacteria may follow along after the maggots, so that the carrots decompose in a soft, vile-smelling mess.

The adult fly is small, about 1/5 inch long, shiny dark green, with yellow hairs, black eyes, yellow legs and head. It lays its eggs about the crowns of host plants, and the yellowish maggots, 1/3 inch long when grown, work down into the soil to the roots. They feed there for a month, then pupate in the soil to produce a second brood of flies in August. There is sometimes a partial third brood attacking late carrots and celery. The winter is spent as brown puparia or as maggots in soil.

Control. To avoid trouble, arrange planting dates to harvest early car-

rots before July 15. Plant in small blocks surrounded by boards, so they can be screened with cheesecloth to prevent egg-laying. Plant late carrots, the main crop, after June 1. Sprinkle naphthalene flakes, 1½ pounds per 100 linear feet, along the row. This treatment is best for carrots grown for storage, since they will taste of naphthalene if used within 1 month of treatment.

Cherry Fruitfly (*Rhagoletis cingulata*)—A white-banded fly common in northern United States on cherry, wild cherry, pear and plum, and, together with the black cherry fruitfly, responsible for most of the wormy cherries. The adults are smaller than houseflies, are black with yellow margins on the thorax and with 4 white crossbands on the abdomen and black bands on the wings.

The winter is passed in brown capsule-like puparia in soil, with flies emerging in late spring—June in central New York. They fly to the trees, feed by scraping surface of leaves and fruit, and sucking up the liquid plant juices. They lay eggs in the fruit through small slits cut in the flesh. The maggots, feeding inside the fruit, produce misshapen, undersized cherries, often with one side shrunken or decayed and turning red before maturity. When full-grown they eat their way out of the fruit, fall to the ground, and produce puparia, spending 10 months of the life cycle in the ground.

Control. Cherries grown commercially for canning, where the fruit is washed by machinery, can be sprayed with lead arsenate, 2½ pounds to 100 gallons of water, but this is not safe in the home garden for fruit to be eaten fresh. Here rotenone sprays, from derris or cube powder, should be substituted even though the results will not be so satisfactory. Apply the first spray a week after the beginning of fly emergence, about when Early Richmond shows color, and the second spray a week to 10 days later.

Currant Fruitfly (*Epochra canadensis*)—A native pest in many sections and common on currants and gooseberries throughout the West. The adult is about the size of a housefly, yellow-bodied with dark-banded wings. It emerges from its puparium in the soil in spring, April or May, and lays 100 to 200 eggs singly in fruit. The whitish maggots cause the fruit to turn red and drop prematurely, after which feeding continues for a few days while the fruit is on the ground before maggots enter soil to pupate. There is one generation a year.

Control. Early-maturing varieties escape most of the damage. A spray consisting of 1 quart of syrup and 2 ounces of lead arsenate to 3 gallons of water, applied immediately the flies emerge and before they can lay eggs, and repeated in 10 days, is said to be the best control measure. Rotenone sprays or dusts might be wiser in home gardens.

Hessian Fly (*Phytophaga destructor*)—One of the most important world pests, causing millions of dollars' loss in wheat and some injury to barley and rye. The original home of the Hessian fly was probably Russia, and it apparently came into this country in straw bedding used by Hessian troops during the Revolutionary War, being noted on Long Island in 1779.

The flies are small, frail, black, the maggots greenish-white, shiny, legless, and headless. They draw sap from stems, causing them to break over and resulting in great reduction in yield.

Although the Hessian fly is not a problem in back-yard gardens, the method of control should interest all gardeners, since it uses forethought instead of toil and sweat. Entomologists in all the wheat states have worked out the life history of the fly so as to give a safe planting date for each location. Metcalf and Flint state results of experiments in Illinois showing that wheat planted before the safe date averaged 39.7 per cent infested, after the safe date only 3.8 per cent infested. The average yield from wheat sown before the safe date was 23.1 bushels per acre, while the yield from wheat planted after this date went up to 28.8 bushels—a gain of more than 5 bushels per acre.

Lacewing Flies—See **Aphid Lions.**

Lesser Bulb Fly (*Eumerus tuberculatus*)—Many small grayish or yellowish wrinkled maggots, ½ inch long, are found in decaying tissues of bulbs of narcissus, hyacinth, amaryllis, onion, iris, shallot. The adult fly is blackish-green with white markings on abdomen, ⅓ inch long, wasp-like. The life history is about the same as the narcissus bulb fly (which see), but the lesser bulb fly is thought to be more of a scavenger on decaying bulbs. In many cases it follows in after the larger bulb fly, but sometimes it is the primary pest of onions and other bulbs.

Marguerite Fly—See **Chrysanthemum Leaf Miner.**

Mediterranean Fruitfly (*Ceratitus capitata*)—The most destructive member of the fruitfly family. It is a potential pest of many deciduous and citrus fruits, including peach, nectarine, plum, grapefruit, orange, apple, pear, quince; also coffee and nearly a hundred other wild and cultivated fruits.

The Mediterranean fruitfly was discovered in Florida in 1929, scattered over an area covering ten million acres. By a most remarkable eradication campaign it was completely exterminated and no insects have been found in this country since 1930, although the fly is known in Bermuda and Hawaii and nearly all subtropical countries except North America. This is one of the very few cases on record of actually eradicating a pest after it had become established in one area, but of course constant vigilance is needed to see that it does not re-enter this country in fruit or in luggage

of travelers. The maggots are inside the fruit, more than a hundred having been taken from a single orange, although the usual number is two or three dozen.

The promptness with which the eradication program was initiated, the fact that adequate state and Federal funds were immediately made available, and the co-operation of all growers contributed to its success. The state was divided into infested zones—the area within 1 mile of any property where the fly had been found—and protective zones, which formed a 9-mile radius outside the infested zones. A host-free period was maintained from May 1 to October 1, prior to which time all ripe fruits had to be shipped or destroyed, and during which time no vegetables could be grown which would reach a susceptible stage during the period. This meant that for a while there were no vegetables or fruits which could be infested by maggots, and any carry-over of adult flies was eliminated by sweetened poison-bait sprays.

Mexican Fruitfly (*Anastrepha ludens*)—A Mexican pest, known also in Texas. This citrus insect is as serious in Mexico as the Mediterranean fruitfly is in the Mediterranean countries, but there are fewer host plants and not so wide distribution. A Mexican fruitfly quarantine now regulates certain areas in Texas and lists as host fruits mangoes, sapotas, peaches, guavas, apples, pears, plums, quinces, apricots, mameys, ciruelas, all species of genus Sargentia, and all citrus fruits except lemons and sour limes. There is a harvesting season when interstate shipment is permitted and a host-free period during which no host fruits are produced or permitted to exist in the regulated areas, except under certain specific conditions.

The adult fly is larger than a housefly, conspicuously marked in yellow or brown. It feeds on honeydew and plant exudations, and lays many long, white eggs under the skin of fruits. Larvae take about 6 weeks for full development, first in the rind, later in the pulp. Pupation is in the ground; there are four generations a year.

Narcissus Bulb Fly (*Lampetia equestris*)—A European species introduced here in bulbs. This is a large, hairy, yellow-and-black fly about the size and appearance of a small bumblebee. It lays eggs on or near crowns of narcissus (preferred host), amaryllis, hyacinth, galtonia, hippeastrum, lilies, and tulips. Ordinarily but 1 maggot develops in each bulb, a fat white to yellow wrinkled form, ½ to ¾ inch long, which soon reduces the bulb contents to a soft brown mass. Puparia are formed in the bulb or in soil; there is usually one generation a year.

Control. When the bulbs are taken up from the field those that are infested are lighter and softer. Bulbs showing evidence of serious infestation should be discarded and burned; others can be treated with hot

water, submerged for 2¼ hours in water held at 110° to 111.5° F. This is a treatment more suited to the commercial grower than the amateur gardener. Cured and cleaned bulbs can also be vacuum fumigated with carbon bisulfide, using 25 to 30 pounds per 1,000 cubic feet for 1¾ hours at a temperature between 70° and 80° F.; but this, too, is for the commercial grower.

Spraying in the field is sometimes successful. A poison bait spray to kill flies calls for 4 ounces sodium fluoride, 1 pound crude glycerine, 2 pounds white sugar to 4 gallons water. The mixture is applied in the heat of the day, in large drops, in sunny, sheltered areas where flies congregate. Recent experiments in the Pacific Northwest indicate that a lead arsenate-mineral oil combination known as W.S.C. dynamite is successful in preventing infestation of narcissus bulbs by larvae of the bulb fly. This is the same spray used in the Northwest for apples. More specific information can be obtained from state experiment stations. Refined naphthalene flakes also offer promise, but should be used with caution to avoid injury to the bulbs.

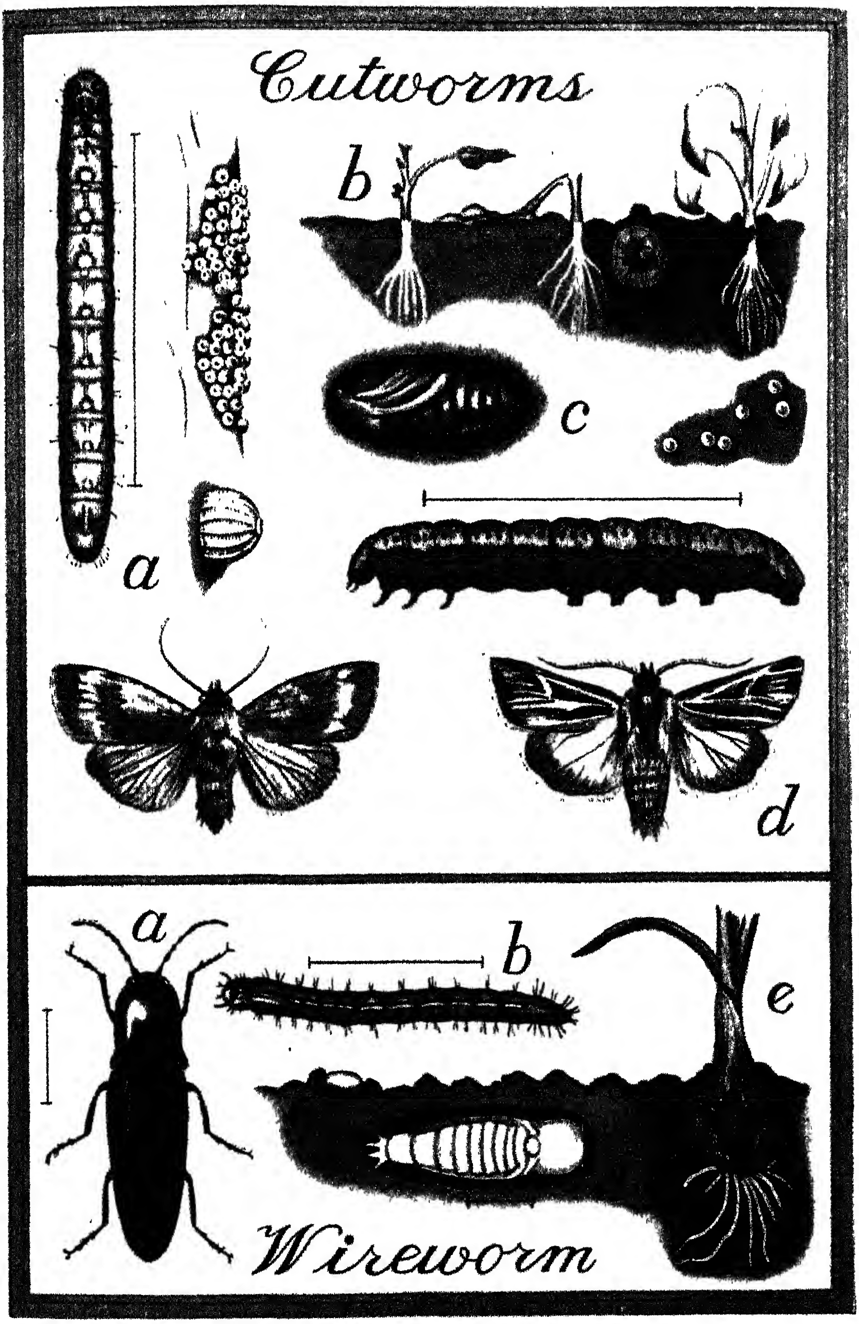
Orchid Fly (*Eurytoma orchidearum*), also called **Cattleya Fly**—A serious orchid pest in greenhouses. Small white larvae feed in bulbs, stems, leaves, and buds of many kinds of orchids. The adult is a small, black, wasp-like fly ⅛ inch long.

Control by cutting out and destroying all infested portions of plants, and fumigate with nicotine or cyanide if necessary, though this may injure blooms. Trapping with sticky baits is recommended. Toads are helpful in catching the flies.

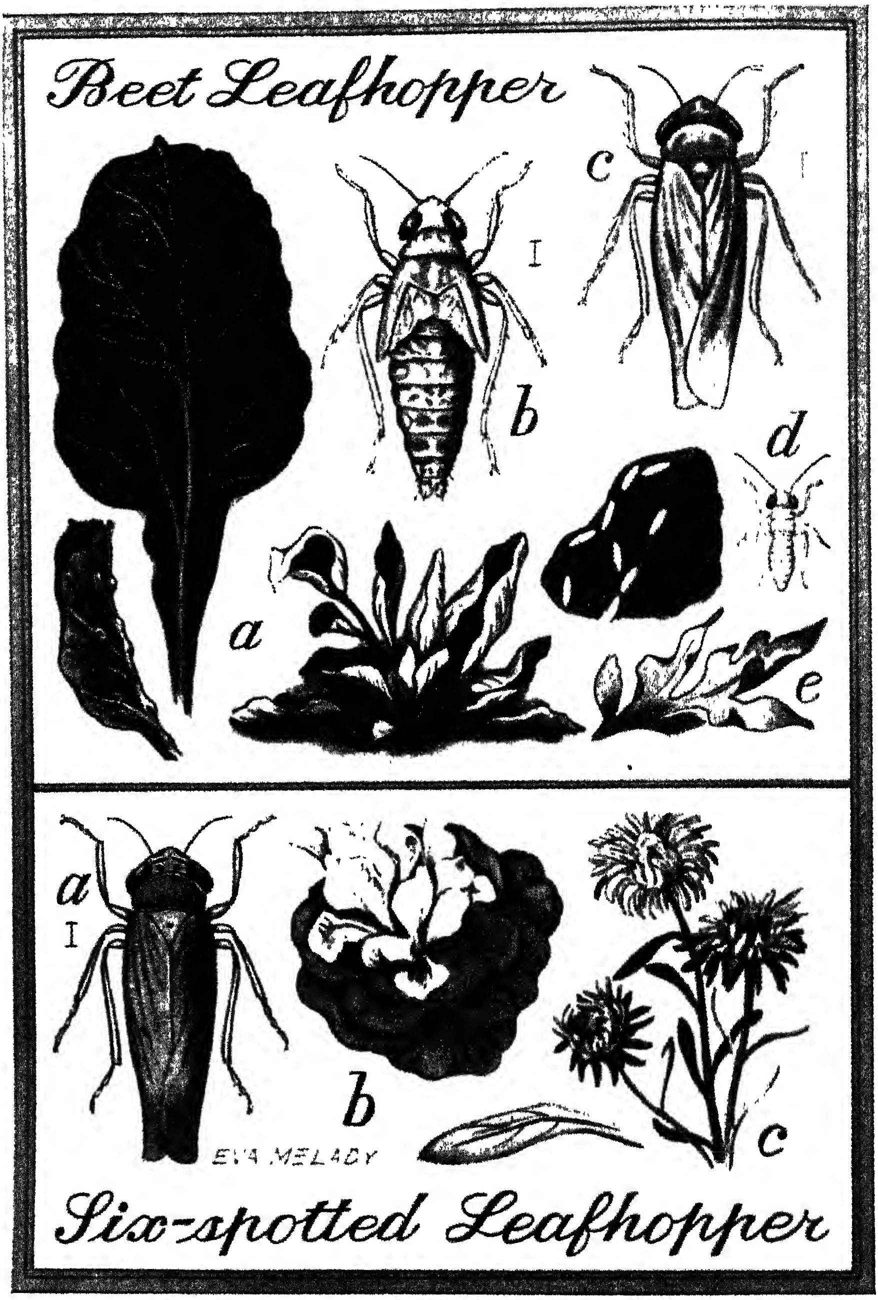
SYRPHID FLIES (family Syrphidae)—Flower flies, or hover flies, form one of the largest families of flies. The adults are bright-colored normally, and feed on nectar and pollen, seeming to hover over the flowers for hours. The chief diagnostic character is the presence of a false or spurious vein in the wings. The larvae of a very few species feed on plants, a few develop in sap exuding from tree wounds, and a few feed on decaying animal and vegetable matter; but the majority are predaceous on aphids and some other insects, most decidedly friends in the garden.

The adults lay white, elongate eggs, singly among groups of aphids. The larvae are footless, elongate, tan or greenish, and one or more of these sluglike creatures is very commonly present in an aphid colony. You, as a gardener, are apt to see the larger syrphid fly larva and kill it without even noticing the young aphids which are your real enemies. If there are many of these larvae on your roses or other plants, withhold all sprays for a few days and give them a chance to clean up, saving you the trouble.

These maggots have pointed jaws by which they grasp the aphid, raise it into the air, and suck out all body contents, leaving the empty skin. A



XXIII **VARIEGATED CUTWORM:** **(a)** larva, egg cluster, and single egg (enlarged), and adult moth. Dingy Cutworm: **(b)** seedlings cut off and cutworm in typical coiled position; **(c)** pupa in soil, eggs, and larva; **(d)** adult moth. **WIREWORM:** **(a)** click beetle adult; **(b)** wireworm larva; **(c)** egg; **(d)** pupa in soil; **(e)** larvae feeding in bulb.



XXIV **BEET LEAFHOPPER: (a)** curly-top disease of beet, the virus transmitted by leafhopper, showing clearing of veins, wartlike protuberances, leaf roll, stunting; **(b)** nymph in fifth instar; **(c)** adult; **(d)** eggs on leaf, lower surface removed to show position; **(e)** tomato leaf showing curly top. **SIX-SPOTTED LEAFHOPPER: (a)** adult, showing 6 black spots; **(b)** yellows disease on lettuce, virus transmitted by leafhopper; **(c)** yellows on aster.

single larva is credited with destroying an aphid a minute over long periods of time, and there may be many larvae in one garden. There is a report that in packing canning peas grown in one Maryland field some years ago operators sieved out 25 bushels of syrphid fly larvae which had almost entirely cleaned up the aphid population in that field.

TACHINID FLIES (family Tachinidae)—The most important group of insect parasites among the flies, and ranking high among beneficial insects. Many species resemble overgrown houseflies, being bristly, grayish, or brown, or black mottled, but without bright colors. They are usually found resting on foliage or flowers. Eggs are either glued to the skin of the host insect or laid on foliage where the insect will eat them along with plant tissue. The early stages of tachinid flies are always parasitic, usually in caterpillars of moths or butterflies, sometimes in adult beetles or their grubs, sometimes in larvae of sawflies, and occasionally in grasshoppers, bugs, or, rarely, in larvae of other flies.

Many species have been imported for our benefit. One, brought in to aid in the control of gypsy and brown-tail moths, parasitizes over a hundred different species of caterpillars. Many are parasitic on cutworms and armyworms. The fly larvae hatch in the body of the victim, feed on muscles and fatty tissues. The caterpillar may not die immediately, and may even form a cocoon, but from this cocoon there emerges the parasitic fly rather than the moth or butterfly of the host insect. When armyworms are abundant there are usually great numbers of tachinid flies buzzing around.

Walnut Husk Fly (*Rhagoletis suavis*)—This species is apparently native to central United States on wild black walnuts, but since 1926 it has been injurious to the English walnut in California, causing a black staining of the shell. The adult is a little smaller than a housefly, with transparent wings and 3 dark, transverse crossbars. The flies are around during July and August to lay eggs in enveloping husks of nuts. The maggots hatch in 4 to 7 days, tunnel through the husks for several weeks, then drop to the ground, or fall with the nuts, and pupate in the soil. Some emerge as flies the next season, others remain in the ground for another year.

The decaying husk makes an ineradicable stain on the shell, making the walnuts unsalable even though the kernels may be sound. A closely related species distributed through the East attacks black walnut and butternut.

The recommended control is cryolite applied as a dust or spray.

FRUITWORMS

Cherry Fruitworm (*Grapholitha packardi*)—A native insect injurious from Colorado north and west. Larvae hibernate in galleries in bark or twigs, pupate in spring, and small mottled gray moths appear in late spring to lay eggs on fruit. The worms, feeding inside cherries, often cause a large crop loss.

Arsenical sprays at the time of egg-laying are recommended, but nicotine and summer oil will leave less poisonous residue.

Cranberry Fruitworm (*Mineola vaccinii*)—Present in nearly every cranberry bog. The moth is ash-gray mottled with black, and has a wingspread of about ¾ inch. In July it lays eggs on the berries, producing pale green larvae which eat into the berries near the stem, closing the hole with silk. A larva eats out the pulp of the first berry, and perhaps 2 or 3 more, before attaining mature size of ⅞ inch. There is one generation a year.

Control. Flood bogs for 10 to 14 days after harvesting and early in May. Destroy infested berries removed by screening.

Gooseberry Fruitworm (*Zophodia convolutella*)—Present in northern states on currants and gooseberries. The adult moth has ashy wings with dark markings, expanding to nearly an inch; the larva is yellow-green with a pinkish cast and darker lines along the sides.

Pupae winter in the ground; moths emerge in time to lay eggs in flowers. The larvae completely hollow out the fruit, 1 worm destroying several berries.

Spraying with arsenicals before the calyx closes is the best method of control, but infested berries should be destroyed also.

Green Fruitworm (*Grapholitha antennata*) and similar species (*G. bethunei, G. laticinerea, G. grotei*)—Generally distributed over eastern states. The larvae feed on nearly all deciduous forest trees, all common tree fruits, and some field crops. Apples are sometimes severely injured, but the fruitworms are not often that abundant.

Hibernation is as an adult, a grayish moth, wing expanse just over an inch, in woodlands or sheltered nooks in the orchard, or sometimes as a pupa in a silken cocoon 2 or 3 inches below ground level. In early spring moths deposit eggs, singly, on twigs and branches. The larvae are pale grass green, some marked with white stripes down each side and a narrow white line down the back. They eat out the side or one end of young apples when they are about the size of marbles, either destroying them entirely or making them worthless even if they continue to grow. When the larvae are full-size, about June 1, they are fat worms 1 to 1¼

inches long. They descend from the tree, burrow into the soil to make their cocoons. There is only one generation.

Control. The most effective measure is a heavy dose of lead arsenate early in the season, at the cluster bud stage, or when fruit buds are just beginning to separate. The calyx spray for codling moth may be too late to control fruitworms satisfactorily.

Raspberry Fruitworm (*Byturus unicolor*)—A most destructive pest of raspberry and loganberry in northern states. Injury is more severe on loganberry, causing some growers to abandon its culture. Yellow-brown beetles, 1/6 inch long, feed on fruit buds and unfolding leaves, and on stamens and pistils when flowers are open. Some buds and flowers are entirely destroyed, others produce distorted berries. Eggs are laid on buds, flowers, or stems, with young grubs tunneling to fruit cores and into drupelets. When the larvae are grown, they drop to the ground and pupate there, producing beetles which remain in the soil until the next April.

Control. About 3 applications of rotenone in the form of a derris, cube, or timbo dust or spray are recommended. The first is applied 7 days after blossoms appear, the second 10 days later, and the third 10 days after the second.

Strawberry Fruitworm (*Cnephasia longana*)—Sometimes troublesome in the Northwest. This insect has recently come from Europe and is established in sections of Oregon and Washington. The larvae, pinkish or gray-white, brownish when mature, 1/2 inch long, tunnel into ripe and green strawberries, leaving affected berries filled with their excrement. Moths, grayish-yellow, wings 3/4 inch across, appear in late June and July, lay eggs to produce larvae which winter in silken cases. They start feeding just before bloom in spring, webbing together leaves and flower petals. There are at least 20 food plants, including Dutch iris, filbert, pea, and some crucifers, besides strawberry.

There is no practical control except hand-sorting affected fruit.

Tomato Fruitworm—See **Corn Earworm.**

GALLS

Insect galls are swellings or deformities of plant tissues caused in some way by the irritation of the insect which thereby obtains lodging, protection from its enemies, and food—all at the expense of the host plant. These plant deformities take the form of blisters on the leaves, or projections from the leaves, bud galls, swellings on stem or twigs, flower galls occasionally, and root galls sometimes.

The late Dr. E. P. Felt in *Plant Galls and Gall Makers* stated that there

are more than 2,000 American insect galls, 805 the work of gall wasps, nearly 700 caused by gall midges, 80 by aphids or jumping plant lice or psyllids, and the rest by sawflies, jointworms, a few beetles, moths, true bugs, and microscopic plant mites. Members of the beech family are favored by 740 of the 805 gall wasps and oaks by 731. Everyone is familiar with the very many different galls on oaks, from the large oak apple to the smallest leaf swelling. Most of these are unimportant as garden troubles.

Many galls have been included in this book under the name of the insect producing them—e.g., spruce galls and grape phylloxera under Aphids, chrysanthemum gall midge under Midge, pear leaf blister mite under Mite, and so on. But a few of those commonly listed under the name of the gall and not the insect are given here.

Ash Flower Gall, caused by a mite (*Eriophyes fraxiniflora*). The staminate flowers of white ash are deformed into galls, ¼ to ¾ inch in diameter, drying and remaining on trees.

Dormant applications of a miscible oil are supposed to give control.

Blackberry Knot Gall—Due to a gall wasp (*Diastrophus nebulosus*). Rounded, knotty, or elongate swellings, 2 to 6 inches long, and often with deep longitudinal furrows, are formed in stems.

There is no control except removal of infested portion.

Blueberry Stem Gall—Due to a gall wasp (*Hemadas nubilipennis*). This kidney-shaped gall, first green, then reddish-brown, is very common on blueberry stems. The insects emerge in spring.

No control is known.

Cottonwood Leaf Gall—See **Poplar Vagabond Aphid.**

Dogwood Club Gall—Caused by a gall midge (*Mycodiplosis alternata*), a club-shaped twig gall, ½ to 1 inch long. Twigs may be killed back several inches.

There is no control.

Grape Phylloxera—See under **Aphids.**

Grapevine Tomato Gall—Caused by a midge (*Lasioptera vitis*). This is a swollen condition of new growth in the form of a green or reddish leaf or tendril gall, ¼ to ¾ inch in diameter, with pinkish maggots inside.

There is no control except removal of infested parts.

Hackberry Galls—The familiar witches' brooms, groups of excessive branches, are really galls due to a mite (*Eriophyes* spp.). There are also numerous twig, bud, and leaf galls.

Hazel Bud Gall—Caused by a mite (*Eriophyes avellanae*). Terminal and sometimes lateral buds are aborted.

Hickory Galls—A great many galls are formed on hickory leaves, most of them by gall aphids or gall midges. The aphid galls (due to *Phylloxera*

spp.) have openings guarded by hairy lobes on upper or under surface of leaves and many small pale yellow or white wingless plant lice within.

The eggs of the hickory stem gall aphid are found in winter on rough places on twigs or in old galls. Young phylloxera crawl to the buds in spring, stimulating them to gall production.

Spraying with a strong nicotine-sulfate-and-soap solution, plus molasses, just before buds swell, is recommended.

Hickory Midges (*Caromyia* spp.) winter in the galls, flying in spring to deposit eggs on underside of young leaves. The galls are varied in appearance but none have openings like the aphid galls.

Maple Bladder Galls—Caused by a mite (*Phyllocoptes quadripes*). They are bladder-like leaf galls, 1/8 inch in diameter.

A dormant spray of lime-sulfur gives control.

Maple Gouty Vein Gall—Caused by a midge (*Dasyneura communis*). Green or red galls, 1/4 inch long, are formed in veins of sugar maple leaves.

Maple Leaf Gall—Caused by a midge (*Cecidomyia ocellaris*). This is a yellow, red-margined blister leaf gall, 1/8 inch diameter.

Maple Spindle Gall—Caused by a mite (*Phyllocoptes aceris-crumena*). Spindle-shaped galls, 1/4 inch long, are formed in leaves of silver maple.

Mossy Rose Gall—Caused by a gall wasp (*Diplolepis rosae*). This gall is a globular mass of moss-like filaments surrounding a cluster of hard cells, each of which contains one larva. The galls appear in June and July with larvae remaining in the cells until spring.

There is no control except removal of infested portions.

Oak Galls—These are far too numerous to describe, or even to single out 1 or 2 for attention. There are a great many leaf galls, as well as the familiar round brown galls known as oak apples. Each one of the latter is really a deformed leaf caused by the attack of a gall wasp. An interesting gall on white, chestnut, and basket oaks is the wool-sower, a globular, white, pinkish-marked woolly growth, 1½ to 2 inches across, on the twigs.

There is nothing for the gardener to do about oak galls.

Rose Root Gall—Caused by a gall wasp (*Diplolepis radicum*). This is a large and conspicuous swelling, 1 to 2 inches across, which may occur at the roots of cultivated roses, but not very commonly.

Cut off such galls.

Spruce Galls—See under **Aphids.**

Tuliptree Spot Gall—Caused by a midge (*Thecodiplosis liriodendri*). This gall is a circular brown or purplish spot surrounded by a circle of yellow or green which shows from both sides of the leaf. Sometimes badly infested leaves drop, but the trouble is not very serious.

No control is known.

Willow Cone Gall—Caused by a midge (*Rhabdophaga strobiloides*). A gray or brown cone-shaped gall, about an inch long, is formed on tips of willow shoots from eggs laid in early May, the gall becoming mature in June.

There is no feasible control.

Witch-hazel Cone Gall—Caused by an aphid (*Hormaphis Hamamelidis*). The cone-gall aphid lays its winter egg in the fall on a witch-hazel twig. The stem mother developing from this feeds on the lower side of the leaf, producing, by its irritation, a tall, cone-shaped gall growing out of the upper leaf surface. Aphids develop in the gall, some of which fly to birch for several generations before returning to witch hazel in the fall. The galls are about ½ inch high, green, sometimes tipped with red.

Witch-hazel Spiny Gall—Caused by an aphid (*Hamamelistes spinosus*). Each flower bud is transformed into a green to reddish elliptical gall, about ¾ inch long, covered with spines. Birch is the intermediate host for this aphid, too, which causes lobed deformations of leaves.

GOPHERS—See under **Mammals.**

GROUND SQUIRRELS—See under **Mammals.**

GRASSHOPPERS

Grasshoppers belong to the order Orthoptera, which includes those insects which have biting mouth parts; 2 pairs of wings with the front wings, called tegmina, somewhat thickened, narrow, elongate, with distinct venation and the hind wings broad and folded fan-like when at rest, or rudimentary or lacking; and gradual metamorphosis. The young nymphs resemble the adults but pass through 5 instars or molts before reaching full size. Except for 1 family, the Mantidae, where we find the predaceous praying mantis, nearly all species of the order Orthoptera are plant-feeders and many of them are enormously destructive.

The locusts or grasshoppers, katydids, and crickets all belong to 1 group or suborder whose members are notable chiefly for the possession of enlarged hind legs for jumping. The crickets, family Gryllidae, have already been discussed. The others belong either to the family Locustidae or the Tettigoniidae.

The family Locustidae, formerly called Acrididae, contains the true grasshoppers, the migratory locusts of the Bible, the locusts that even in our time may measure 2,000 square miles in a swarm over the Red Sea; the locusts that horrified some of us older gardeners in the moving picture made from Pearl Buck's novel, *The Good Earth;* the locusts that have devastated our own American crops in the West every so often. These

are quite different from the so-called seventeen-year locust, which is a cicada, a sucking insect whose damage is relatively insignificant.

Grasshoppers or true locusts are moderately long insects, slightly deeper than wide, dark-colored, variously mottled, with prominent jaws and eyes, antennae always much shorter than the body, and an "ear" on the first abdominal segment. The ovipositer or egg-laying apparatus consists of 4 short, finger-like pieces which are used to thrust the eggs an inch or less into soil or soft wood. These eggs are formed into masses of 20 to 100, and surrounded by a gummy substance which hardens to form a case, the whole being called an egg pod. They feed in the daytime and are most destructive to plants.

Members of the family Tettigoniidae, formerly called Locustidae, are the long-horned grasshoppers, green meadow grasshoppers, katydids, cave and camel crickets. These are less hardy than true grasshoppers, usually green, often active at night, characterized particularly by very long antennae (often longer than the body), 4 segments in each tarsus, ears on the base of front legs, the ovipositer sword-shaped, and eggs laid singly or in rows on or in leaves, stems, twigs, sometimes in soil. They eat either plants or small animals and not many species are garden pests.

Control. The time-honored control measure for grasshoppers is the use of poison bait. It has been estimated that about two million dollars' worth of bait, used by American farmers in 1 year, saves about a hundred million dollars' worth of crops, a 50 to 1 return on investment. Blister beetles are also useful, since in their young stages they feed exclusively on grasshopper eggs.

There are 2 bait formulae in general use; the quantities given are for a lot 50 × 100 feet.

Formula A
(The Water or Kansas Bait)

1½ lbs. bran
1 oz. poison (sodium arsenite or paris green or white arsenic or sodium fluosilicate)
¼ pt. molasses (optional)
1 pt. water

Formula B
(The Oil Bait)

1½ lbs. bran
1 to 1½ ozs. poison (sodium arsenite or paris green or white arsenic or sodium fluosilicate)
¼ pt. lubricating oil, 20 to 30 S.A.E.

Hardwood sawdust or ground corncobs can be substituted for half the bran, which should be coarse flakes. For grasshoppers, which feed during

the day, the bait is scattered early in the morning. If it is broadcast very evenly and not left in little lumps or piles there is less danger of harming animals or birds.

American Grasshopper (*Schistocerca americana*)—Common short-horned eastern field grasshopper, not one of the more destructive forms.

Carolina Grasshopper (*Dissosteira carolina*)—Common throughout the country, most numerous in late summer and fall along roadsides. It is very large, nearly 2 inches long, brown, mottled with specks of gray and red. The hind wings are black with yellow margins and the grasshopper flies readily when disturbed. This is not a very destructive grasshopper, but one nearly everyone is apt to see.

Clear-winged Grasshopper (*Camnula pellucida*)—Variable in color, yellow to dark brown with black spots on tegmina, only an inch long, with migratory habits. This species occurs throughout North America but is most damaging in Utah, Wyoming, Montana, Idaho. It feeds on grains, grasses, garden crops, and may invade vineyards and orchards. Egg pods may be very abundant in breeding places. Plowing up such small areas to destroy eggs is very effective in controlling this particular grasshopper.

Devastating Grasshopper (*Melanoplus mexicanus devastator*)—A small, yellow-brown species with black markings, including a row of spots along the middle of tegmina. Recorded in every state west of the Rocky Mountains, this species is a pest chiefly in California, where it is the state's most devastating grasshopper; in southern Oregon, Nevada, and Arizona.

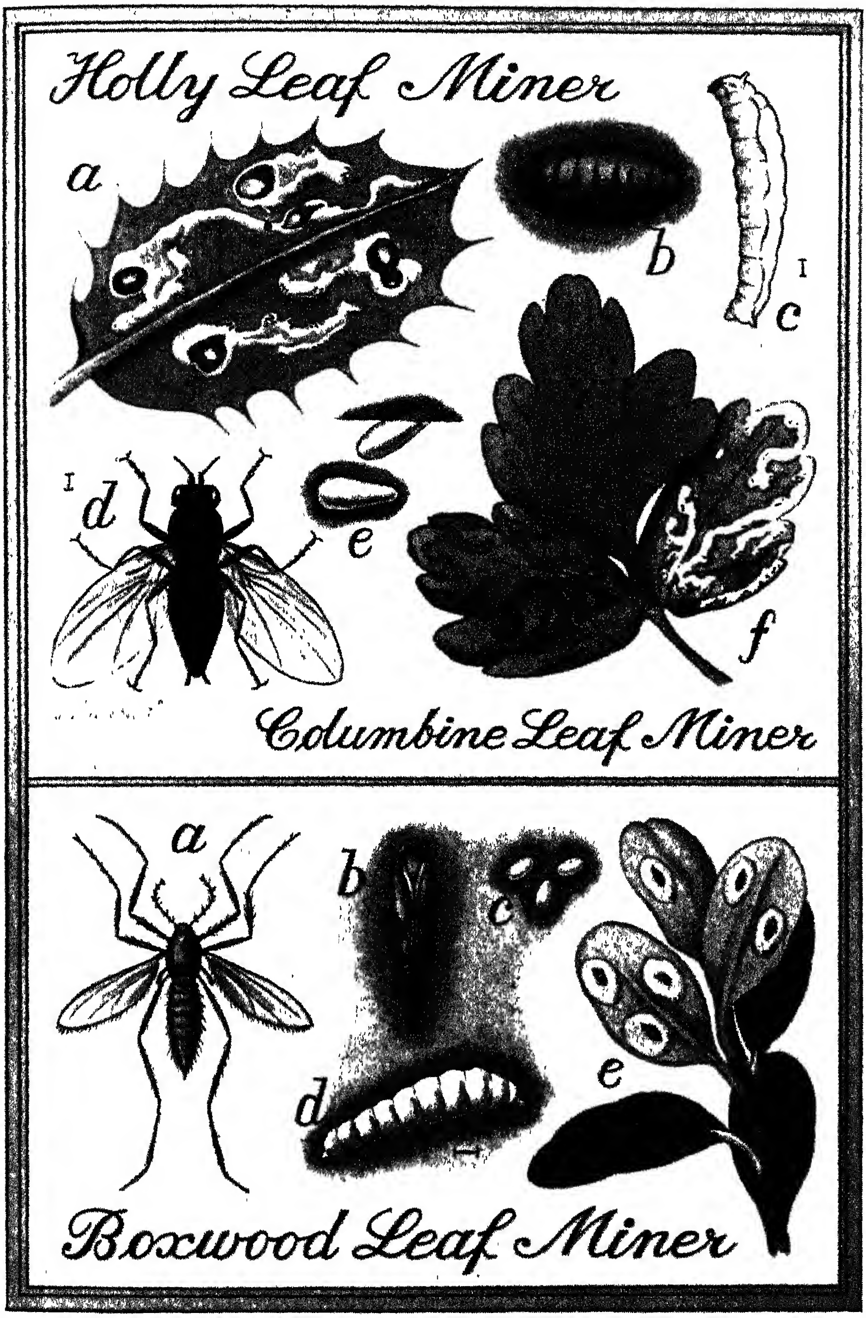
Differential Grasshopper (*Melanoplus differentialis*)—Next to the Carolina grasshopper in size. It is 1½ to 1¾ inches long, beautifully colored a shiny yellow or amber brown, with young nymphs green or brownish. It is distributed generally throughout the country but is fairly rare in the East. It prefers succulent vegetation, feeding on field and garden crops and deciduous fruit trees. In dry years differential grasshoppers persist only in irrigated areas or along streams.

Eastern Lubber Grasshopper (*Romalea microptera*)—Sometimes called Florida lubber, a large, stout, short-winged, clumsy locust attacking grass, flowers, and other ornamentals in Florida and other southern states.

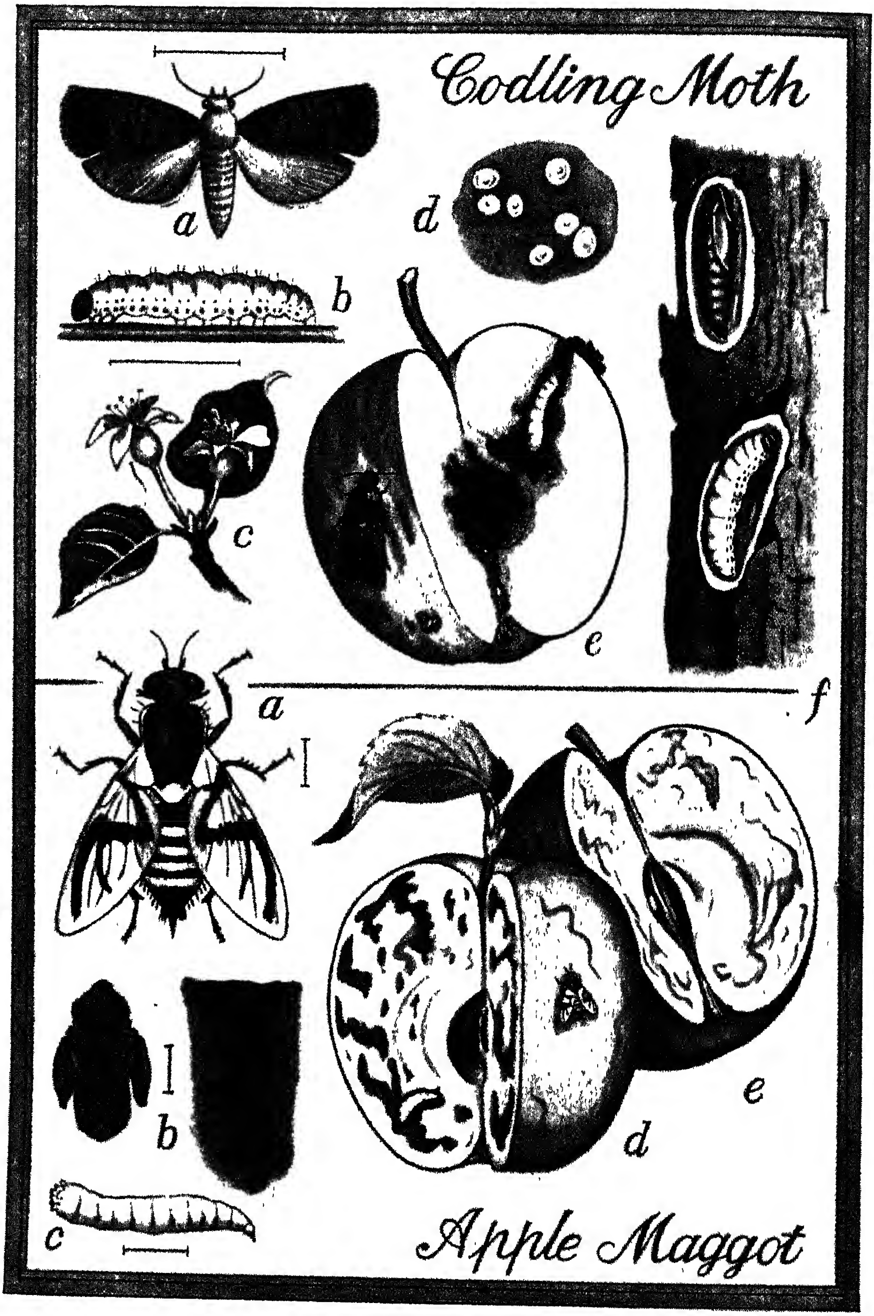
Lesser Migratory Grasshopper (*Melanoplus mexicanus mexicanus*)—Small, about an inch long; a strong flier found nearly everywhere in this country but more seriously abundant west of the Mississippi River.

Lubber Grasshopper (*Brachystola magna*)—A large, short-winged species common and injurious from Montana to New Mexico, ranging east of the Rocky Mountains and in the Great Basin.

Red-legged Grasshopper (*Melanoplus femur-rubrum*)—One of the smallest of injurious species. It is common along roadsides, very injurious to legumes, and particularly to soybeans in the Middle West, where it



XXV **HOLLY LEAF MINER: (a)** holly leaf showing blotch and serpentine mines from underside; **(b)** pupa; **(c)** larva; **(d)** adult fly; **(e)** eggs (b, c, d, e much enlarged). **COLUMBINE LEAF MINER: (f)** leaf showing typical serpentine (winding) tunnels or mines; an older infestation at left. **BOXWOOD LEAF MINER: (a)** adult fly (color should be orange); **(b)** pupa (actual color orange, darkening toward head); **(c)** eggs; **(d)** maggot; **(e)** leaves showing blister mines with "windows."



XXVI **CODLING MOTH:** **(a)** adult; **(b)** larva or "worm"; **(c)** stage of fruit when first worms enter; **(d)** eggs (enlarged); **(e)** larva tunneling outward, moth on surface of apple and sting, lesion caused by second-brood larva entering apple; **(f)** larva in winter position under bark scales and pupa formed in spring. **APPLE MAGGOT:** **(a)** adult fly; **(b)** pupa, enlarged, and puparium (containing pupa) natural size in soil; **(c)** maggot (larva); **(d** and **e)** injury to fruit, with maggot at work and female puncturing apple skin to lay eggs.

cuts through the pods, causing seeds to mold. It is brownish-red with hind thighs (tibia) pinkish-red with black spines. More injurious in the North than the South; it feeds on truck crops, vines, fruit trees.

Rocky Mountain Grasshopper (*Melanoplus mexicanus spretus*)—Present in western states between the Rocky Mountains and the Sierra Nevada and Cascade Mountains, and in the Great Plains area. This is the most famous of all the destructive migratory locusts in our country. It is able to survive on dry native grasses as well as on nearly all cultivated crops. It lays eggs over a wide area in many situations and is about the same size and color as the red-legged grasshopper but with legs not quite so pink. The larger nymphs may migrate many miles, up to 200, in great swarms from breeding places to more succulent vegetation. This species was particularly injurious to crops during the years 1862 to 1887, almost causing starvation in some years. Then it disappeared as an important pest for a long time, starting periodic swarming migrations again about 1930.

Two-striped Grasshopper (*Melanoplus bivittatus*)—A common, widely distributed species. This is a stout grasshopper, 1 to 1½ inches long, with an olive body, a yellow stripe extending from head to top of wing, and a dark stripe on upper half of hind leg. It does not survive drought conditions, preferring rank growth near streams. It may be a serious pest of grains, vegetables, fruit trees, and all cultivated crops.

HORNWORMS

Hornworms are large caterpillars, the larvae of sphinx moths, bearing a pointed projection at the end of the body that looks like a horn. The 2 common hornworms found in gardens feed rather interchangeably on tobacco and tomato and some other solanaceous plants.

Tobacco Hornworm (*Protoparce sexta*), also known as **Tomato Worm**—Distributed throughout the Americas. It is an awe-inspiring caterpillar, 3 or 4 inches long, green with 7 oblique white stripes and a red horn projecting at the rear. It feeds voraciously on tomato, tobacco, eggplant, pepper, potato, groundcherry, and related weeds.

The hornworm winters in soil as a brown, hard-shelled pupa, with a slender tongue case projecting down like a pitcher handle. The adult moth, often called a hawk, or hummingbird moth, emerges in May or June to feed at dusk, hovering over petunias and similar flowers to sip nectar with its long tongue. It has a wing spread of 4 to 5 inches, is gray or brown with white and dark mottlings and 6 yellow spots on either side of the abdomen. (Plate XIX, page 206.)

The female lays greenish-yellow eggs singly on underside of leaves; the young larvae hatch in a week, feed for 3 to 4 weeks, shedding their skins 5 times as they increase in size. When full-grown they go down into the soil 3 or 4 inches to pupate. There is one generation in the North, two or more in the South.

Control. Picking off caterpillars by hand is often sufficient control in the small garden. If hornworms are too numerous, keep foliage dusted with 1 part calcium arsenate to 3 parts lime, or sprayed with 1 tablespoon calcium arsenate and 2 tablespoons lime per gallon of water. Treat every 7 to 10 days until young fruits form. In many sections cryolite can be used in place of calcium arsenate. A bait to attract and kill moths, before they can lay their eggs, is a 5 per cent solution of tartar emetic in isoamyl salicylate as an attractant, exposed in an open pan.

Do not destroy caterpillars covered with oval white objects attached to the skin by one end. These are cocoons of a parasitic braconid wasp. The female thrusts her eggs inside the hornworm body; when the larvae hatch they feed for a while inside the caterpillar, and then eat their way outside to spin cocoons. If left undisturbed more wasps will emerge to parasitize other hornworms.

Tomato Hornworm (*Protoparce quinquemaculata*), also called **Tobacco Worm**—This hornworm is almost identical with the other species and feeds on the same plants. It is identified by 5 instead of 6 yellow spots on the abdomen of the moth, and 2 narrow dark stripes extending diagonally across each hind wing. The larva has 8 instead of 7 diagonal white stripes and they join a horizontal white stripe forming a series of V's. The horn is green with black sides.

The nomenclature of these 2 hornworms seems rather mixed up. Tobacco hornworm as the common name of *Protoparce sexta* and tomato hornworm for *P. quinquemaculata* are taken from the approved list of common names published by the American Association of Economic Entomologists. Most textbooks, however, reverse this, using tomato hornworm with *P. sexta*. So far as the gardener is concerned it makes no difference—both species feed on tomatoes and related vegetables.

KATYDIDS

Katydids belong to the family Tettigoniidae, the long-horned grasshopper group, discussed more fully under Grasshoppers, and characterized by very long filamentous antennae and a sword-like ovipositor in the female.

Eastern Katydid (*Pterophylla camellifolia*)—Heard after dusk and all night in late summer and autumn saying "Katy did, Katy didn't."

The song is made by special stridulating organs on the wings of the males, though the females can make faint sounds. Adults have delicate gauze-like dark green wings; live in colonies in highest treetops in the North. Eggs are laid in crevices of bark of trees or soft shrubbery, hatch in the spring, and reach adult form by July or August. There is only one generation a year.

False Katydids (numerous species), or **Bush** or **Roundheaded Katydids**—Mostly arboreal in habit, passing entire lives on shrubs or trees and feeding on leaves, with males singing at night. The eggs are laid in double rows on edges of leaves or glued to twigs and do not hatch until spring. There is only one generation a year.

Katydids cannot really be called garden pests. The slight amount of feeding on foliage is not enough to call for control measures.

LANTERN FLIES

Lantern flies have many names. They are sucking insects closely related to leafhoppers and are often called lightning leafhoppers. They belong to the family Fulgoridae and are called fulgorids; sometimes they are called mealy flata for their white powdery or mealy covering. They look something like treehoppers, short and squat, not so streamlined as leafhoppers, and with antennae fastened down to their "cheeks." The name lantern fly came from the erroneous belief that the head of certain tropical species was luminous. There are only a few species in this country of interest to gardeners.

Corn Lantern Fly (*Peregrinus maidis*), also known as **Corn Leafhopper**—Considered one of the worst enemies of corn in Florida. The species is very abundant in late August, killing nearly every stalk of young corn before it reaches tasseling stage. The adult is yellowish-green, 1/6 inch long, and has clear wings longer than the body with dark markings near the tip. Lantern flies collect in large numbers near buds and in axils of leaves.

Control. Dust buds of corn with nicotine-lime dust.

Lightning Leafhopper, Mealy Flata (*Ormenis pruinosa; O. septentrionalis*)—A very active insect, jumping quickly when approached. It is just over 1/4 inch long and has purple or brownish wings entirely covered with a white powdery material. Tree trunks or branches are covered with white flocculent strands concealing the young nymphs. The hoppers are common on mulberry, viburnum, Japanese cherry, hawthorn, and other small trees, on honeysuckle, wild grape, and other vines, and on various shrubs and herbaceous plants, including lilies. Eggs are laid in slits in the bark of twigs and covered with a white waxy secretion. There is one generation a year, with adults present in August and September.

Although mealy flata are often conspicuous in late summer there is seldom enough injury to call for control measures. A nicotine-soap spray can be tried if it seems necessary.

LEAF CRUMPLER

Leaf Crumpler (*Mineola indigenella*)—Abundant in Upper Mississippi Valley and northern states on apple, plum, prune, crabapple, quince, cherry, wild cherry, wild plum, and pear. The crumpler is a caterpillar, dark brown, somewhat hairy, 1/3 to 1/2 inch long, spending the winter in curved cases or cocoons, made by crumpling dead leaves and tightly fastening them to an apple twig. The nests are 3/4 to 1 1/2 inches long.

In spring, just when apple buds open, the worms loosen their cases and feed on opening buds, fastening new leaves together with silken threads. They pupate in May and June; adults are brownish moths with white mottlings; wingspread 3/4 inch. They lay eggs on leaves, the caterpillars of the next generation appearing in 2 to 3 weeks. They make curved, cornucopia-shaped cases in which they feed for the rest of the season and then use for winter quarters.

Control. If trees are sprayed regularly for codling moth and other pests, leaf crumplers will not be much of a nuisance. If they are present, be sure that lead arsenate is applied at cluster bud, calyx, and the 3-week-later applications. If young trees become infested, spray in August with lead arsenate and soybean flour.

LEAF CUTTER

Maple Leaf Cutter (*Paraclemensia acerifoliella*)—This is a small caterpillar which feeds between upper and lower leaf surfaces, cuts out peculiar oval sections, 1/10 to 1/2 inch across, to serve as a case, in which it lives over winter in leaf litter. This casebearer is more prevalent in the Adirondack regions.

Morning Glory Leaf Cutter (*Loxostege obliteralis*)—A caterpillar relative of the garden webworm, feeding on leaves of morning glory and wandering Jew. Spray with lead arsenate.

LEAF FOLDER

Grape Leaf Folder (*Desmia funeralis*)—Widely distributed from coast to coast. The larva is a greenish-white caterpillar, about an inch long when mature, feeding inside folded portion of leaves. The adult is a small black-and-white moth.

In the East the injury is little more than a ragged look to the foliage, but in California there may be extensive damage to late-maturing grape varieties, the larval attacks being followed by decay of fruit. Here leaves are rolled tightly on the underside instead of being folded over. Pupation is inside the rolled or folded leaf and there are usually two broods. An arsenical spray is effective if applied before the folding protects the larvae. There are a number of parasites.

LEAFHOPPERS

Leafhoppers belong to the insect order Homoptera along with aphids. They have a gradual metamorphosis, with nymphs resembling adults, piercing-sucking mouth parts, 4 wings which are similar in make-up and held in a roof-like position when at rest. Leafhoppers are distinguished by their elongate, wedge-shaped appearance and their hopping habit, for they are very active and jump quickly when disturbed. By their feeding on plant sap leaves lose color, turn whitish, often in a stippled pattern. There is also a general loss of plant vigor, sometimes stunting.

Some leafhoppers, as the potato leafhopper, actually cause a diseased condition in the plant known as tipburn or hopperburn. Authorities are divided as to whether this comes from a toxin injected by the insect into plant tissues or from an interference with translocation of plant carbohydrates, but probably both factors are at work.

Another grave charge laid against leafhoppers is the transmission of important virus diseases: aster yellows, yellow dwarf of potatoes, curly top of sugar beets and other plants, cranberry false blossom, peach yellows.

Control. Leafhoppers are controlled by contact insecticides, usually nicotine sulfate, or pyrethrum, or by repellents such as bordeaux mixture or a zinc-lime whitewash and, recently, by the new chemicals DDT and the related Rhothane. Present experiments indicate that bordeaux mixture really is more than a repellent, that copper is actually taken up by the leafhopper during the sucking process.

Apple Leafhopper (*Empoasca maligna*)—Present east of the Rocky Mountains, except in the lower Mississippi Valley. During late summer and fall apple foliage turns pale, the green upper surface flecked with many small white spots and the underside covered with dark bits of excrement and often with white cast skins. Nymphs and adults are greenish-white. There is one generation a year, and no migration to another type of host, as with the potato leafhopper, and the winter is spent in the egg stage under loose bark.

A nicotine-sulfate spray or pyrethrum dust gives control where necessary, usually in older apple orchards.

Aster Leafhopper—See **Six-spotted Leafhopper.**

Bean Leafhopper—See **Potato Leafhopper.**

Beet Leafhopper (*Eutettix tenellus*)—A western species dangerous as a vector of curly-top disease. This leafhopper varies from pale green in spring to dark brown toward winter, which it spends as an adult. It normally breeds on weeds—salt bush, Russian thistle, greasewood, filaree, and other wild hosts in arid foothills or desert. Egg-laying takes place in March and the first generation matures on these wild plants. (Plate XXIV, page 231.)

From early May to June the adults of this generation fly in swarms, often hundreds of miles, alighting in sugar-beet fields. As they feed they introduce the curly-top virus into the plants. They are the only known vectors of this disease which makes the leaf veins warty, the petioles kinked, the leaves rolled and brittle on the edges, and finally stunts and kills the whole plant. From eggs inserted in veins, leaf petioles, or stems, nymphs hatch in 2 weeks, becoming adult in 3 to 8 weeks. There may be one to three generations.

When the beets are plowed out, swarms of leafhoppers, carrying the virus, spread out to all neighboring vegetation, infecting tomato, table beet, cantaloupe, celery, cucumber, pepper, spinach, squash, and other vegetables, and many ornamental flowers—geranium, nasturtium, pansy, and zinnia, among others. The symptoms in all plants are the same as in beets—curled leaves, stunting, often death.

Control. Both insects and disease are very difficult to control. In home gardens diseased plants should be rogued out as soon as noticed. The leafhopper flies too quickly to be killed by contact insecticides. Often commercial sugar-beet fields have to be given up. The fog belt along the coast of California is fairly free from leafhopper attacks and there are a number of natural enemies—the lacewing fly and other predators, several egg parasites, and a fungus disease.

Blunt-nosed Leafhopper (*Euscelis striatulus*)—Famous as the vector of cranberry false-blossom disease, found from Wisconsin east. From 1895 to 1905 this disease practically exterminated susceptible cranberry varieties, but the insect transmitter was not known until 1926. This hopper is light brown, short, with a rounded blunt nose. It winters in the egg stage and hatches in May. Apparently there is one brood a year. Flooding the bogs in late June when young nymphs are present, and spraying or dusting with pyrethrum, together with use of resistant varieties, give fair control of the disease and its vector.

Clover Leafhopper (*Aceratagallia sanguinolenta*)—This insect lives over winter as an adult, keeping within it the virus causing yellow dwarf of potatoes. Disease is most prevalent in potatoes grown next to clover.

Grape Leafhopper (*Erythroneura comes*)—A native species occurring in all grape-growing areas, but most serious in the Great Lakes region and in Arizona and California. This is a small, slender leafhopper, ⅛ inch long, yellowish with red markings; the summer forms are more yellow, the hibernating adults nearly all red. Grape is the chief host, but feeding may occur on apple, beech, blackberry, currant, dewberry, gooseberry, grasses, maple, plum, raspberry, strawberry, Virginia creeper, Boston ivy. Small white spots appear all over grape and other vine leaves, the general color changes to pale greenish-yellow, leaves often turn brown and shrivel.

The adults winter in weeds and refuse, become active on vines in early spring on warm days, move to green leaves when they are about half out, and lay eggs in late April. Pale greenish nymphs start sucking in May, are full-grown in 3 to 5 weeks. There are two generations in the North; usually three in California and the South.

Control. Nicotine sulfate with a small amount of casein spreader added seems to be the most effective contact insecticide, killing those nymphs and adults actually hit. In the Middle West nicotine sulfate is added, with a pinch of soybean flour, to a 4-4-50 bordeaux mixture. Pyrethrum sprays or dusts are satisfactory. Cleaning up rubbish around the vines in fall is helpful too.

Other species of *Erythroneura* also infest grape and Virginia creeper.

Norway-maple Leafhopper (*Alebra albostriella*)—An insect causing some injury near New York City. Swollen twigs on Norway maple, looking as if diseased, are produced by egg-laying under the bark. Foliage is infested with numerous small yellowish hoppers.

Control. Spray with nicotine sulfate and soap in early spring if control should be necessary.

Plum Leafhopper (*Macropsis trimaculata*)—An eastern pest important as a vector of 2 virus diseases, peach yellows and little peach, affecting peaches, nectarines, plums, almonds, and apricots. The leafhopper, short, blunt, with 3 dark spots, is a strong flier and may travel long distances, although usually it stays near the tree where it was hatched. There is only one generation a year, eggs laid on peach twigs in July and August not hatching until the next May.

The disease transmitted by this leafhopper shows up as small pale yellow leaves growing on excessively branched twigs with a witches'-broom effect. The leaves droop and curl, fruit ripens prematurely, is blotched with red, and is watery and insipid to taste. An infected tree never recovers but remains a source of infection.

Poplar Leafhopper (*Idiocerus scurra*)—Occasionally abundant on poplar.

Potato Leafhopper (*Empoasca fabae*)—Abundant on many plants

over the eastern half of the United States and west to Colorado and Wyoming in regions where the average annual rainfall is 25 inches or more; also present, sparingly, in California. (Plate XIV, page 151.) This small, 1/8 inch long, wedge-shaped green leafhopper, with white spots on head and thorax, plays many roles. Down South it is known as the bean jassid, since there it is most important as a bean pest. It is responsible for dahlia stunt, potato tipburn or hopperburn, peanut pouts, and other "diseases" as well as normal leafhopper injury.

Apparently the potato leafhopper does not winter in the North but migrates from the South each season and is not serious here until midsummer. It winters in the Gulf states, breeding on alfalfa and other legumes, on castor bean and weeds. Coming North in the spring it feeds first on apple foliage, migrating to beans as soon as the plants are up, often coming suddenly in swarms. When potatoes are several inches high the hoppers move over to them, laying eggs in main veins and in petioles. Each female lays 2 or 3 eggs a day for 3 or 4 weeks. The eggs hatch in 10 days, with nymphs full-grown at the fifth molt or about 2 weeks. There are two generations and a partial third in central states, so leafhoppers infest both early and late potatoes.

On potato, eggplant, rhubarb, dahlia, and horsebean the condition known as hopperburn is prevalent—first a triangular brown spot at the tip of the leaf, then similar triangles at the end of each lateral leaflet or the entire margin rolling upward and turning brown, often looking scorched and with only a small part of each leaf along the midrib staying green. The yield of potatoes is cut enormously; dahlias may be so stunted they do not flower.

On bean and apple, leafhopper feeding produces whitening of foliage and often stunting, dwarfing, crinkling, and curling leaves, but not the brown burned effect. This same potato leafhopper has also become a rather important citrus pest in parts of California, puncturing and blemishing the fruit rind.

Control. Spraying with bordeaux mixture controls leafhoppers on potatoes as well as taking care of fungus blights, but DDT seems most effective at the present time and gives rather remarkable increase in yield. Wettable sulfur sprays, at the rate of 1 pound to 10 gallons, are also said to give control. For potato leafhoppers on other vegetables, apples, and ornamentals, spray with nicotine sulfate and soap or with pyrethrum, being sure to cover lower leaf surfaces. Sulfur dust is recommended for leafhoppers on peanuts and a zinc-lime whitewash as a repellent on citrus trees in California.

Red-banded Leafhopper (*Graphocephala coccinea*)—Probably the most conspicuous leafhopper common on garden flowers, including aster,

calendula, gladiolus, hollyhock, rose, and zinnia. The front wings are gaudily decorated with alternate bands of magenta-red and green or blue. The injury does not seem to be very serious.

Rose Leafhopper (*Typhlocyba rosae*)—Imported from Europe and attacking most plants of the rose family, but primarily apple and rose, being an especially serious apple pest in the Northwest and sometimes in New England. It hibernates in the egg stage, usually in rose canes, but sometimes in apple bark or berry canes. The adults, creamy-white to light yellow, produce characteristic light stippling and sometimes a yellowing and slight curling of foliage, but no hopperburn. Eggs for the second generation are laid in July in leaf veins and petioles. Adult hoppers are found defacing rose leaves late into the fall. (Figure 62.)

Figure 62

Rose leafhopper and feeding pattern caused by sucking

Control. Nicotine sulfate and soap or pyrethrum sprays will control this leafhopper. Triogen is effective on rose, and probably other combination sprays containing a contact insecticide will be satisfactory if applied frequently.

Six-spotted Leafhopper (*Macrosteles divisus*), also known as the **Aster Leafhopper**—This species, formerly thought to be the European *Cicadula sexnotata,* is tremendously important to the gardener because it transmits the virus disease known as yellows, not only to aster but many other ornamentals, among them alyssum, anchusa, browallia, cape-marigold, cornflower, calendula, chrysanthemum, cineraria, clarkia, coreopsis, cos-

mos, gaillardia, gypsophila, lobelia, mignonette, petunia, phlox, poppy, rudbeckia, scabiosa, schizanthus, strawflower, sweet william, vinca, and zinnia. Lettuce and celery are particularly subject to yellows, and the virus may also cause disease symptoms on carrot, parsnip, parsley, and other vegetables, as well as grain crops. Symptoms vary with the different plants, but there is a general yellowing of foliage rather than a definite mottled or mosaic pattern as with some other virus diseases. There is usually a clearing of affected veins, plants are always stunted and usually distorted, with excessive branching and shortening of internodes. Asters sometimes have green petals; lettuce develops a condition known as rabbit ear.

The leafhopper responsible for all this trouble is greenish-yellow with 6 black spots. It winters in the egg stage on perennial weeds or flowers—chrysanthemum, asclepias, erigeron, plantago, or dandelions. The virus is not carried in the egg and the hoppers have to feed on infected plants in the spring and then hold the virus for at least 10 days, more often 18, before it can be transmitted to asters and other garden plants. Nymphs in early instars do not transmit the disease because the period between each molt is shorter than the latent period of the virus. At normal summer temperatures the cycle from egg to egg is about 40 days, so there may be several generations in one season. (Plate XXIV, page 231.)

Control. Insects actually hit with the spray or dust will be killed by contact insecticides, but the only sure way of growing asters in regions where six-spotted leafhoppers and the yellows disease are prevalent is to grow them under cheesecloth, as the commercial aster growers do. Make a wooden frame and cover with cheesecloth or muslin, not coarser than 20 threads to the inch.

Dust vegetables in home gardens with pyrethrum or rotenone to control leafhoppers partially, and rogue out (remove and destroy) all plants showing yellows symptoms.

Three-banded Leafhopper (*Erythroneura tricincta*)—Common on grape, Virginia creeper, apple, and in some parts of the Middle West more injurious than the Grape Leafhopper, which see.

Three-cornered Alfalfa Leafhopper (*Stictocephala festina*)—Supposed to be a western alfalfa pest, this leafhopper is a nuisance in Florida on beans, cowpeas, tomato, watermelon, and is common on hickory, oak, goldenrod, and viburnum. It is larger than the potato leafhopper, yellow-green, and has an outline of a triangle when viewed from above.

Virginia Creeper Leafhopper (*Erythroneura vulnerata*)—Another species similar to the grape leafhopper, feeding on grape, elm, Boston ivy, Virginia creeper, and rose. Control with Red Arrow or other pyrethrum sprays or Black Leaf 40.

White Apple Leafhopper (*Typhlocyba pomaria*)—This species has two generations, one in May and one in September, blanching the leaves white. Observations in Virginia indicate that it is most numerous on succulent, rapid-growing varieties such as Stayman, Winesap, and Delicious, and on apples which have been regularly sprayed, indicating that sprays applied during a normal apple-spray schedule are more apt to kill numerous leafhopper parasites than the nymphs themselves. Removing water sprouts, favorite sites for leafhopper eggs, and avoiding cultivating under trees when parasites are in cocoons in soil, together with timing sprays for leafhopper adults instead of nymphs, will reduce leafhopper injury without reducing parasites to any great extent.

LEAF MINERS

Leaf miners are insects which feed between 2 leaf surfaces. Sometimes they are caterpillars, sometimes maggots or flies, or larvae of sawflies, and they make blotch mines or blisters or a serpentine tunnel through the leaf. Casebearers and leaf cutters are really miners but have been considered separately. Since the miner is protected by the host plant most of its life, control depends on a rather exact knowledge of the life history of the individual miner.

Alder Leaf Miner (*Kaliosysphinga dohrnii*)—A European species distributed through the Northeast on European alder. The adult is a small black sawfly; the larvae are whitish, ⅓ inch long. The latter winter in papery cocoons in soil and pupate in spring. Sawflies appear in May to lay eggs in slits in upper leaf surface which turns yellow in that area. There may be 10 or more of these blister mines in a single leaf. There is a second generation in July and sometimes a third in September.

Nicotine and soap are somewhat effective in control.

Apple Leaf Trumpet Miner (*Tischeria malifoliella*)—An eastern insect reported also from Oregon. Numerous trumpet-shaped mines are made in leaves, pupation taking place there. Very small moths, dark, with narrow fringed wings, emerge through slits in the leaves. There are two or more broods.

Apple leaf miners are not considered serious enough in cultivated orchards to call for special control measures.

Arborvitae Leaf Miner (*Argyresthia thuiella*)—Distributed from Maine to Missouri, very common in home plantings. Very small larvae, ⅕ inch long, green with a reddish tinge, black head, short bristles across the back of each segment, mine in the leaves, eating out the inside. The leaves turn brown, yellow, tan, or whitish with the mined tips standing

out prominently. (Figure 63.) In serious cases all the foliage is mined and the shrub turns brown all over. Larvae pupate in May, and small moths, grayish, wingspread only 1/3 inch, fly in May and June, laying, in leaves, eggs which hatch in late June.

Control. For a few plants the easiest control is to cut off infested discolored tips and burn them. A nicotine-soap spray in late May and early June will kill some moths but is only partially effective. There are at least 2 parasites helpful in reducing the arborvitae leaf miner.

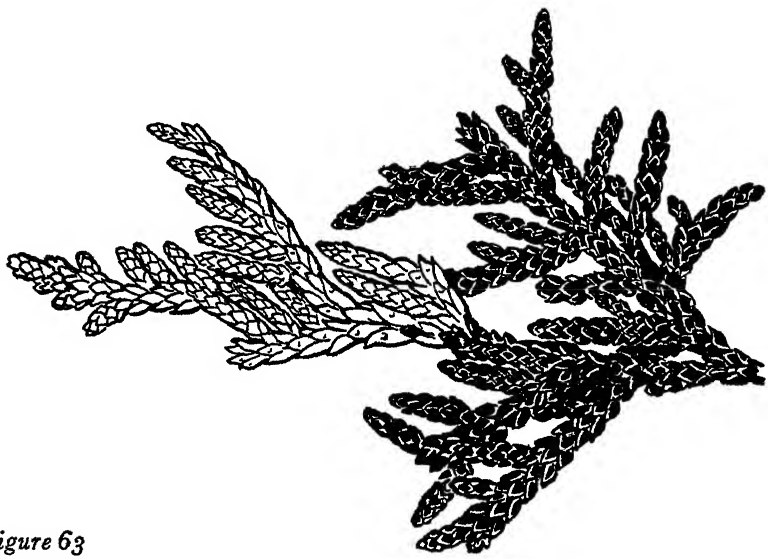


Figure 63

Twig mined and discolored by arborvitae leaf miner

Asparagus Miner (*Agromyza simplex*)—Present through northeastern states and on the West coast. Apparently this is a minor pest, the yellowing and death of foliage often attributed to it usually being due to other causes. The adult is a very small fly which winters in puparia in tunnels in stalks or below ground, and flies in May, laying eggs under the epidermis. The maggot larvae feed in the stems for 3 weeks and then pupate for a second generation.

Special control measures, except cutting and burning injured stalks, are probably not justified.

Azalea Leaf Miner (*Gracilaria azaleella*), also called **Leaf Roller**—More serious as a greenhouse than a garden pest. Eggs are laid in leaves by a small moth, wingspread 1/2 inch or less. Small yellow caterpillars hatch in 4 days, enter the leaves and feed between surfaces, causing blisters. When partly grown the larvae emerge and start to roll leaves, feeding

inside the protection of the roll. A cocoon is made inside a leaf rolled in from the margin.

Spray with arsenate of lead before leaves are rolled and tied together.

Basswood Leaf Miner (*Baliosus ruber*)—Known for 120 years as a pest of basswood throughout its range. The adult is a wedge-shaped beetle which feeds also on oak, linden, and apple, and winters under leaves and trash beneath host trees. Active in May, it feeds on leaves for some time, with skeletonizing conspicuous by June. Eggs are laid singly at the edge of an area skeletonized by the female and covered with excrement. The larvae start feeding inside the leaf in single mines, then several together in a common mine. Spiny pupae are found in the mines in August; beetles emerge to do more feeding on foliage before hibernation.

Control by spraying with lead arsenate spring or fall when beetles are feeding.

Birch Leaf Miner (*Fenusa pusilla*)—An imported sawfly, relatively recent, present in Middle Atlantic states. Leaves of gray, paper, European white, and cut-leaf birch, and especially terminal leaves of young trees, are injured by a brown blotch mine which often covers more than half the leaf. This is a common pest of specimen trees on lawns. Small black sawflies, about 1/4 inch long, lay eggs in succulent leaves in late May, causing small blisters. The larvae on hatching penetrate through the tissues of about half the leaf, which turns brown. There are two or three broods a year.

Control. Spray in late May with nicotine sulfate and soap or nicotine and oil, repeating a week later and again in July for the second brood.

Blackberry Leaf Miner (*Metallus rubi*)—Sometimes important in the Northeast. The miner is a very small sawfly; the larvae, 1/3 to 1/2 inch long, with brown heads, work between leaf surfaces causing blotch mines, plants often looking as if singed by fire. There are two broods a year.

Control measures are not yet known.

Boxwood Leaf Miner (*Monarthropalpus buxi*)—The most common and destructive of boxwood insects. It is a European fly, established in the East in 1910, present in Rhode Island, Connecticut, Pennsylvania, New York, and Maryland, probably some other states, but not as yet too much of a problem in the lovely boxwood plantings of Virginia, the Carolinas, and Georgia. There is only one brood of the boxwood leaf miner a year and for most of that year the insect is protected, inside the leaf, from all poison sprays or dusts. (Plate XXV, page 238; Figure 64.) The mines are small blotches or blisters in which 1, sometimes 2 or 3 yellow to orange maggots feed. In spring, some days before emergence, a small opaque window is formed on the underside of the leaf, in the middle of the blotch, and on tearing open the leaf the maggots are found to have

pupated and to have dark heads. Shortly after that the windows are broken, the pupae push part way through the leaf, and when the flies emerge they leave white pupal skins hanging on the leaves.

The flies are brilliant orange, midge-like, 1/8 inch long. They appear in swarms early in the morning, usually with more flies emerging over a period of 10 days to 3 weeks. The exact date of emergence varies with the season. In Maryland it may be late April. My earliest record in New Jersey is May 8 and the latest May 20, with the average about May 14. Dr. Pyenson reports that the pupae start getting dark heads the first or second week in May on Long Island. In Cincinnati, Ohio, Mr. C. R. Runyan reports flies out on April 25, 1945. Emergence is often a few days earlier when plants are on the south side of buildings.

Figure 64

Boxwood leaf miner: flies laying eggs, maggots inside blistered surface, pupa cases protruding from mines

The flies mate very shortly, the male dies, and the female completes her egg-laying within 1 or 2 days, inserting white, oval eggs through the upper leaf epidermis. They start hatching in 2 weeks and the new blotch mines or blisters made by the maggots can be seen by midsummer. Seriously infested plants are not killed, at least not for several years, but they have a most unthrifty yellow appearance with sparse foliage and are very much of an eyesore in a lovely garden.

Control. Because of the short period the insect could be reached by insecticides it has been extremely difficult to control this leaf miner satisfactorily. The standard recommendation has been to spray with a mixture of 1 part cheap spray molasses diluted with 5 parts of water, plus 1½ teaspoons nicotine sulfate per gallon. This sticky spray had to be in place before the flies emerged and attempted oviposition, and had to be renewed immediately after each rain, unless the sprayed bushes were covered with canvas during the 10 to 20 days when flies were active. Even with all this work the results were far from perfect and in rainy seasons there was very little control.

Now, however, DDT comes to the rescue. Dr. Louis Pyenson has published results of 1945 experiments on Long Island and Mr. C. R. Runyan results in Ohio. Both state that 1 application of DDT in advance of fly emergence had a residual effect for several weeks and gave complete control. In Ohio DDT was used at the rate of 2 pounds of a 20 per cent wettable dust per 100 gallons of water and appeared to give 100 per cent control on a boxwood hedge where 93 per cent of last year's leaves were infested, with an average of 6.6 larvae per leaf but some leaves containing up to 15 larvae. Dr. Pyenson found this powdered form satisfactory and a miscible-oil form of DDT, known as Gesarol Emulsion and used at a dilution of 1 to 200 gallons, even better since it gave the same complete kill, had a long residual effect, and did not leave any noticeable residue on the foliage.

Since DDT will be on the market in many different forms, follow manufacturer's directions for a dosage which will be approximately equivalent to 1 pound of actual DDT in 200 gallons of water. Watch the boxwood in sunny, warm locations particularly, tear open a few blisters every day or so, and make the treatment when heads of the pupae start turning brown.

Chrysanthemum Leaf Miner (*Phytomyza chrysanthemi*), known also as Marguerite Fly—Leaves and petioles of chrysanthemum, marguerite, cineraria, eupatorium, daisy, Shasta daisy, and other members of the composite family are mined by pale yellow larvae of a minute black fly. The mines are irregular, light-colored, extending over the surface just under the epidermis; the larvae feed on parenchyma cells; badly infested leaves dry up and hang on plants. Tunnels are filled with black specks of excrement and pupation is inside the mines. This fly is rather common in outdoor gardens and greenhouses in most parts of the United States.

Control. Since the larvae are so near the surface, just under the epidermis, they can be killed with a strong 1 to 400 or 1 to 600 nicotine-sulfate-and-soap spray. This means 1½ to 2 teaspoons nicotine per gallon. Repeat 3 or 4 times at weekly intervals.

Columbine Leaf Miner (*Phytomyza aquilegiae*)—Very common in gardens. Striking white winding tunnels, filled with black bits of excrement, are seen on leaves in almost every clump of columbine. The adult is a small brownish fly which lays eggs on underside of leaves. When the pale maggots are grown they emerge through crescent-shaped cuts and attach brown puparia to the leaf, with flies coming out in about 2 weeks. There are several generations a season, with pupation of the last brood in the soil. (Plate XXV, page 238.)

Control. Nicotine-sulfate sprays applied when the first mines are seen

may have some effect. Removing and burning of infested leaves is recommended, but this often means denuding the whole columbine clump unless you start early and keep ahead of the miners.

Corn Blotch Leaf Miner (*Agromyza parvicornis*), also known as **Wheat Leaf Miner**—An eastern species ranging west to Utah. The adult is a minute black fly whose maggots make irregular blotch mines in corn, barley, other grains, and grasses. The injury is worse in young corn. There are several generations in Florida, with breeding throughout the winter.

The miner cannot be reached by insecticides. Pull up and destroy seriously infested plants; plant an excess of corn, to have a good stand left after the miners get their share.

Cottonwood Leaf Miner (*Proleucoptera albella*)—Prevalent from Arizona to Wyoming. The adult is a minute white moth with 2 yellow spots bordered with black near tip of fore wings. White eggs are glued to the leaves in parallel rows. Larvae are lemon-yellow, 1/3 inch long, and mine all of the leaf except veins and epidermis. Cottonwoods are often completely defoliated. The winter is spent as pupae in cocoons, sometimes in bent leaves on trees, occasionally on the ground under trash. The larvae are heavily parasitized but no artificial control measures are known.

Delphinium Leaf Miner—See **Larkspur Leaf Miner.**

Eggplant Leaf Miner (*Keiferia glochinella*)—Attacking eggplant and other solanaceous plants in the South. Larvae and moths are like those of the potato tuberworm but slightly reduced in size.

There are several parasites which keep this insect relatively unimportant, not requiring man-made controls.

Elm Leaf Miner (*Fenusa ulmi*)—An imported species attacking chiefly English, Scotch, and Camperdown elms, but sometimes injuring American elm. Small shiny black sawflies lay eggs through slits in upper leaf surfaces. In late May larvae, whitish, legless, 1/3 inch long, make blotch mines in leaves, often 15 to 20 larvae working in one leaf, which turns brown and shrivels. There is only one generation and after about 3 weeks of feeding the larvae remain in brown papery cocoons in the soil until pupation the next May.

Control. Spray trees as soon as there is any indication of mines, and while larvae are small, with nicotine sulfate and soap.

Hemlock Leaf Miner—See **Spruce Leaf Miner.**

Holly Leaf Miner (*Phytomyza ilicis*)—A European fly well distributed across the country on English and American holly. Yellow or brown or grayish serpentine tunnels or blotch mines are produced in leaves by a small, yellow-white maggot, 1/6 inch long. Pupation is in mines, small black flies emerging about May 1 in New Jersey, earlier farther south.

Control. Pick off and burn infested leaves. If this is done promptly and

regularly before all leaves are infested no other control is necessary. For serious infestation spray with nicotine sulfate, 1 teaspoon to a gallon, plus a 1 to 100 dilution of a white summer oil such as Volck, when the flies emerge. Or spray with arsenate of lead, 4 tablespoons to a gallon with Kayso added as a sticker, as soon as new leaves are formed. British Columbia, which grows a great deal of holly for Christmas shipping, has imported a number of parasites, which seem to be quite successful in getting rid of the leaf miner. (Plate XXV, page 238; Figure 65.)

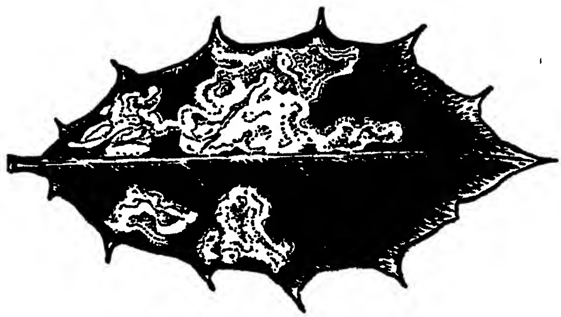


Figure 65

Work of holly leaf miner

Larkspur Leaf Miner (*Phytomyza delphiniae*)—A fly common on delphinium, larkspur, aconitum. Several larvae feed together to form light-colored tan to brown blotch mines filled with dark flecks of excrement. The mines may cover half or more of a leaf, which looks more blighted than injured by an insect. Pupation is generally on the outside of a leaf near a mine.

Control. Pick off and burn infested leaves as soon as noticed; clean up all old plant parts spring and fall. Spray with nicotine sulfate when first mines are noted.

Lilac Leaf Miner (*Gracilaria syringella*), or **Leaf Roller**—A European moth first known in America in 1925. It is reported from eastern states and in the Puget Sound area on lilac, privet, and ash chiefly, sometimes on euonymus and deutzia. The moths, brownish, with 6 yellow lines on the fore wings, lay eggs in vein axils on underside of leaves. The larvae, faint yellow, ¼ inch long, first mine and then roll and skeletonize the leaves. There are several generations, the larvae of the last hibernating in cocoons in soil. When this miner is abundant the beauty of lilacs and other shrubs is spoiled. Probably much browning of lilac foliage thought due to disease is caused by the lilac leaf miner.

Control. Pick off and burn infested leaves and spray with a strong solu-

tion of nicotine sulfate (1 tablespoon per gallon) and soap in May or early June, as soon as first sign of infestation occurs. A second application may be required 2 weeks later.

Locust Leaf Miner (*Chalepus dorsalis*), also known as **Locust Leaf Beetle**—Distributed throughout eastern United States south to Virginia and west to Missouri, and especially injurious on Long Island. Preferring black locust, it may also feed on birch, elm, dogwood, wild cherry, apple, white oak, as well as bean, clover, peanut, and soybean. The beetle is ¼ inch long with black head and appendages, and a black stripe down the inside of orange-red wing covers. Larvae are yellow-white with black heads. Beetles are active in spring when locusts are coming into leaf and the eggs are laid in a pile on top of each other. The larvae burrow from the bottom of this mass into the leaf, making a circular mine. There may be one or two generations and the entire foliage of a tree may be killed twice in one summer unless it is sprayed in May with arsenate of lead.

Lodgepole Needle Miner (*Recurvaria milleri*)—A special pest of lodgepole pine in the Sierra Nevadas in California, important in the recreational area where it sometimes kills 80 per cent of mature trees in epidemic years. Adult moths appear only every other year to lay eggs behind twig and needle scales and around buds. The larvae on hatching move to a needle, mine that the first year, then move to another needle for a second year.

Spraying trees every other year with "inverted" lead arsenate plus nicotine and oil offers promise of protecting camp sites.

Mock Orange Leaf Miner (*Agromyza melampyga*)—Larva of a fly making curved, linear mines in leaves. The mines later expand into blotches.

No control is known.

Morning Glory Leaf Miner (*Bedellia somnulentella*), also known as **Convolvulus Leaf Miner**—Small, pale caterpillars, larvae of small gray moths, make irregular mines in leaves, at first serpentine, later widening into blistered blotch mines. Pupation is in cocoons attached to leaves.

There is no recommended control except destruction of infested leaves, but spraying with nicotine sulfate or lead arsenate as for other miners would probably help.

Palm Leaf Miner or **Skeletonizer** (*Homaledra sabelella*)—The major pest of palms in Florida. So far as known the larvae attack only trees of the family Palmaceae, feeding on saw, cabbage, dwarf, and sabal palmettos, on coconut palm, and the various date palms. The caterpillars are gregarious, living in colonies of 35 to 100, feeding under a protective web of silk and depositing their excrement in the upper surface of this web. Continued feeding causes dark brown blotches on leaves, followed by

shriveling and death. In heavily infested areas every frond and leaflet may be attacked. The moths, which are rarely seen in the day, though attracted to lights at night, lay eggs on a brown papery husk which encloses young leaflets. Young larvae start to feed directly from the bottom of the eggs on leaf tissue, keeping the eggshells as protection until the silken web is formed. There are several generations, usually five a year.

Control. Spraying with lead arsenate in January, April, July, September, and November will control the insect but leave a noticeable residue on leaves. The addition of a dye, malachite green, to the spray makes the residue less objectionable.

Parsnip Leaf Miner (*Acidia fratria*)—A small green and yellow fly. The larvae, pale yellow or greenish, ¼ inch long when grown, form blotch mines, usually in lower leaves, in spring and pupate in the leaves.

Control measures have not been recommended.

Pine Needle Miner (*Exoteleia pinifoliella*)—A common insect sometimes abundant on ornamental pines. Brown larvae, only ⅕ inch long, mine the tips of needles, usually entering at some distance from the point, and then excavate the whole leaf. Injured tips turn yellow, dry up. There may be three generations, with moths of the first brood appearing in June.

Spraying in early spring with nicotine and oil seems to be helpful.

Privet Leaf Miner (*Gracilaria cuculipennella*)—A European insect sometimes destructive in North America. Whitish caterpillars, ⅞ inch long when mature, make blotch mines in leaves, then leave the mines and feed externally in rolled leaves.

Control measures are the same as for the lilac leaf miner.

Serpentine Leaf Miner (*Liriomyza flaveola* or, as given in most texts, *Agromyza pusilla*)—A near relative of the corn blotch miner, common throughout the country. The yellow maggots, larvae of minute black and yellow flies, make long, winding white mines under epidermis of bean, beet, cabbage, cowpea, cress, nasturtium, sweet pea, pepper, potato, radish, spinach, turnip, watermelon, as well as field crops. Pupation is in the mines or in brown puparia in soil. There are several generations. In addition to decreasing the attractiveness of green vegetables for food, the mines afford entrance to disease and decay organisms.

No practical control measures are known, except removal of infested leaves, but spraying with nicotine is said to have been successful in California.

Shadbush Leaf Miner (*Nepticola amelanchierella*)—Producing a broad, contorted mine with irregular edges, usually near the base of a leaf.

Spinach Leaf Miner (*Pegomya hyoscyami*)—Well known to former Victory gardeners. A slender gray fly, with a white face, lays oval, white,

sculptured eggs singly or in small groups on undersides of leaves. These hatch in 3 or 4 days into pale green or whitish maggots which enter the tissues, feed between leaf surfaces, causing large, light-colored blotch mines filled with dark flecks of excrement. Spinach, Swiss chard, table and sugar beets, mangels are attacked as well as weeds like lamb's quarter, chickweed, and nightshade. Several maggots may be found in a single mine and may migrate from one leaf to another. Pupation is usually in the soil, occasionally on top of the ground in trash or in mines. There are several generations—three or four in a normal season. Leaf vegetables are made unfit for greens, while seed and root development are checked.

Control. Remove and destroy infested leaves. Destroy weeds as sources of infestation. Grow spinach very early in spring or late in fall to escape injury, or cover with cheesecloth to keep flies from laying eggs. Sometimes spraying with nicotine sulfate at a 1 to 600 dilution has given control on beets but is not generally satisfactory for this pest.

Spruce Leaf Miner (*Epinotia nanana*), or **Hemlock Leaf Miner**—Attacks spruces, fir, hemlock. Olive-green caterpillars with brown heads feed at base of needles, making mines as they advance, and sometimes web terminal needles together. The very small moth has gray head, black abdomen, brownish wings marked with black.

Tupelo Leaf Miner (*Antispila nyssaefoliella*), or **Sour-gum Casecutter**—This is a tiny moth the larvae of which mine in the leaves of tupelo (sour gum). When the caterpillar is mature it cuts an oval case out of the leaf and falls to the ground, attaches the case to some object by a silken thread, and pupates inside. It is abundant in some years in some localities. My only experience with it was on an estate in Pennsylvania some years ago, when all the gardeners stopped working to wonder at the bits of leaves walking around on the ground. At that time every leaf on the tree seemed to have been infested.

Control by spraying with arsenate of lead plus nicotine.

Unspotted Tentiform Leaf Miner (*Parornix geminatella*)—Commonly found in orchards but not very destructive in most states. In Kansas, however, it is noted as being injurious to apple, pear, quince, and cherry leaves, causing blister mines, several in a leaf, and sometimes early defoliation.

Nicotine sulfate and a summer oil emulsion added to second and third codling-moth cover sprays gives reasonable control. Destruction of trash and leaves in fall is helpful.

Verbena Leaf Miner (*Agromyza platyptera jucunda*)—Practically inevitable in any garden producing verbenas. Blotch mines are formed near the margins of the leaves. (Figure 66.) The maggots work singly

but there may be several mines in a single leaf, which may run together.

Control. Pick off infested leaves; spray with nicotine sulfate and soap; clean up plant remains in autumn.

Figure 66

Blotch mines caused by verbena leaf miner

White Blotch Leaf Miner (*Phyllonorycter hamadryella*)—Common in the Northeast on oak. Each larva makes a whitish blotch mine in upper surface of a leaf, one leaf often having many mines. The young larva is grub-shaped but as it matures it becomes a small caterpillar about 1/5 inch long. It pupates in the mine, emerging as a tiny moth, white with bronze bands. Hibernation is as a larva in dry leaves on ground; hence raking and burning leaves in autumn is the best control.

Wild Parsnip Leaf Miner (*Phytomyza albiceps*)—A European species generally distributed. It makes serpentine mines in aster and columbine. The larvae are whitish; puparia black; flies small, black or metallic blue. Pupation is in the soil.

LEAF ROLLERS

Leaf rollers are caterpillars which feed protected by the rolled-up leaf of the host plant. Many leaf rollers belong to the family Tortricidae, the members of which are small moths with broad, square fore wings.

Basswood Leaf Roller (*Pantographa limata*)—The larva is bright green with a black head, about 1 inch long. In late summer it cuts leaves halfway across the middle and lives inside the cut portion rolled into a tube. When full-grown it leaves this nest and makes a small one lined with silk, in a fold from one edge of the leaf, spending the winter in this protection in fallen leaves. The moth, appearing in August, is straw-colored with intricate olive-purple markings and a 1½-inch wingspread.

Control. Rake and burn fallen leaves in fall or early spring.

Bean Leaf Roller (*Urbanus proteus*)—A southern pest troublesome

to early fall-planted crops of beans. The caterpillar is greenish-yellow, velvety, with a brownish head attached by a constricted neck. It is about 1 inch long, rolls up edges of leaves after cutting slits in them. The adult is a blue skipper butterfly, 2 inches across, with long tails on the hind wings. It lays eggs on beans in summer. In warm weather larvae take 14 days to mature; later in the fall they take a month. Pupation is on the plants. By September beans in Florida are often so heavily infested that no pods can be formed.

Control. Spray beans with a weak solution of lead arsenate, using only 1 ounce powdered lead plus 1 ounce of hydrated lime to 4 gallons of water.

Cherry Tree Tortrix—See **Ugly Nest Caterpillar.**

European Honeysuckle Leaf Roller (*Harpipteryx xylostella*)—Appearing on Tartarian honeysuckle. Leaves are rolled and ragged from feeding of larvae, which are leaf-green with two chocolate-brown median stripes outlined with blue-green stripes, 3/4 inch long, tapering to a narrow head and tail. The white cocoon, pointed at both ends, is fastened to a leaf and the moth emerging is chestnut-brown with cream-colored lower margins on fore wings, spreading to 4/5 inch.

Control. Spray with lead arsenate to prevent defoliation.

Fruit Tree Leaf-Roller (*Archips argyrospila*)—Present in the northern half of the country, from coast to coast. This caterpillar may, in occasional years of abundance, ruin from 80 to 90 per cent of the apple crop. It may also feed on nearly all kinds of deciduous fruits, forest trees, and some herbaceous plants—apricot, ash, blackberry, boxelder, cherry, currant, elm, gooseberry, locust, loganberry, oak, onion, pear, plum, poplar, prune, quince, raspberry, rose, English walnut, and willow.

The fruit tree leaf roller winters in the egg stage, in masses of 30 to 100 eggs plastered on twigs, branches, and tree trunks, covered with a brown or gray varnish. They hatch about the time apple buds separate in spring, the young worms, pale green with brown heads, crawling to leaves, buds, and small fruits to feed for about a month. They spin a light web around several leaves, roll these together, often enclosing a small cluster of young apples. Cavities eaten into apples show as deep russeted scars at harvest. When the larvae are full-grown, 3/4 inch long, they pupate inside folded or rolled leaves or make a flimsy cocoon on trunk or branches. Moths emerge in late June or July; they have brownish fore wings mottled with gold, expanding from 3/4 to 1 inch. They mate and lay eggs for the next year, there being but one generation.

Control. Many parasites work on the fruit tree leaf roller but do not always control it, nor do poison sprays, even when heavy applications of arsenicals are made. A very heavy application of a dormant-oil spray, put

on before the buds break, seems most effective. The spray must hit every egg mass on larger branches or smallest twigs.

Hickory Leaf Roller (*Argyrotaenia juglandana*)—The inch-long, yellow-green larvae roll hickory leaves and feed inside the rolls. The moth is dark brown with dark oblique bands on the fore wings.

Life history and control are not fully known.

Larger Canna Leaf Roller (*Calpodes ethlius*)—Ranging through the South and north to Washington, D.C. The larvae, transparent pale green caterpillars with head and thorax spotted and tinged with orange, feed on and roll leaves of cannas. They are often quite destructive. The adult butterfly is dark brown with several small white spots.

Spraying with lead arsenate with some sticker added will probably control if applied before the leaves are rolled. Cryolite is helpful.

Oak Leaf Rollers (*Argyrotoxa semipurpurana, Tortrix quercifoliana,* and *T. albicomana*)—These leaf rollers winter as inconspicuous egg masses on bark, with greenish, dark-headed caterpillars feeding on new leaves in spring. Sometimes they are abundant enough to defoliate oaks in woodlands.

Spray with a dormant miscible oil to kill eggs, or with a stomach poison for young larvae.

Oblique-banded Leaf Roller (*Archips rosaceana*), also known as **Rose Leaf Tier**—The omnivorous larvae of this moth feed on flowers in greenhouse and garden, chewing holes in rosebuds, rolling up leaves and tying them together, feeding on aster, carnation, geranium, sunflower, verbena. They also feed on vegetables, ornamental shrubs and trees, and fruits, including apple, apricot, ash, basswood, bean, birch, blackberry, boxelder, celery, cherry, currant, dewberry, dogwood, gooseberry, hawthorn, hazelnut, honeysuckle, horsechestnut, lilac, loganberry, maple, oak, peach, pear, plum, poplar, prune, raspberry, strawberry, sumac, thistle.

The young, pale green, black-headed larvae mine the leaves first, then work from the underside inside rolled areas, often tying several leaves together. They may also infest the fruit. The moth is reddish-brown with irregular dark lines on the front wings which expand just over an inch. Eggs are laid in overlapping green masses on branches of host plants or on rose leaves in greenhouses.

Control. Remove rolled leaves. Dust flowers and other ornamentals with a mixture of 85 parts sulfur to 15 parts lead arsenate, or spray with lead arsenate. For fruit trees use directions for fruit tree leaf roller. There are a number of natural parasites.

Red-banded Leaf Roller (*Argyrotaenia velutinana*)—A native insect injurious north of Ohio and west of the Mississippi River, in California and widely scattered localities. It is similar to the oblique-banded roller,

feeding on apple, cherry, plum, some small fruits, vegetables, and ornamentals. The moth appears in spring, is about the size of a codling moth, is brownish with a broad red band and light irregular markings on fore wings. The larva is slender, greenish, just over ½ inch long, and pupates in fall inside a half cocoon on trees or other objects. There may be three generations. Eggs of the first are placed on bark, later on foliage or fruits. Early-season larvae feed on foliage, spinning light webs, but late-season larvae attack fruits, eating patches off the surface.

Special control measures are not necessary for trees protected by a codling-moth spray program. A number of parasites help in control.

Spirea Leaf Roller (*Olethreutes hemidesma*)—In late summer, in some seasons, leaves of new shoots of *Spirea vanhoutei*, and perhaps other species, are webbed together by velvety dark-green caterpillars with rows of white tubercles. Spray with lead arsenate in July, before larvae start webbing, and clip off any nests formed.

Strawberry Leaf Roller (*Ancylis comptana fragariae*)—A European species now present in northern United States and also in Louisiana and Arkansas, feeding on strawberry, blackberry, raspberry, and dewberry. The roller is a small greenish or bronze caterpillar, up to ½ inch long, which folds leaves together with silken tubes and feeds from inside the tubes. Plants are weakened, leaves turn brown and die, fruits are withered and deformed, infested beds appear white or gray from a distance. Adults, small gray moths, ½ inch across fore wings with light waxy markings, appear in large numbers near the strawberry patch in May to lay eggs on underside of leaves. After the larvae have finished feeding, in 35 to 50 days, they pupate inside folded leaves. There are two or more generations.

Control. Dust or spray with cryolite or lead or calcium arsenate when first blossoms appear or at first sign of rollers. Repeat twice more at weekly intervals. If spraying is required after fruits are formed, use rotenone or pyrethrum. Mow strawberry beds close to the ground and burn over right after harvest, if the leaf roller is a serious problem in your garden.

A nicotine-sulfate-oil spray applied between the time first larvae appear and leaves are rolled seems to be satisfactory, and a strong pyrethrum dust may be effective even after leaves are rolled.

Sweetpotato Leaf Roller (*Pilocrocis tripunctata*)—Bluish-green caterpillars, up to 1 inch long, feed inside folded leaves, eating holes through the leaves and skeletonizing.

Western Strawberry Leaf Roller (*Anacampsis fragariella*)—Occurring in Washington and Oregon along with the strawberry leaf roller. The caterpillars are creamy-pink, ½ inch long. Injury occurs in May and early June, when leaves are rolled, with moths emerging in July. Hibernation is

in the egg stage on old strawberry leaves. There is only one generation a year. A nicotine-and-oil spray, 1 teaspoon nicotine sulfate to a 1 to 100 dilution of summer oil, applied when eggs are numerous on foliage, is effective.

LEAF SKELETONIZERS

These caterpillars are much like leaf rollers but they feed more openly, eating out everything except epidermis and veins, without the protection of conspicuously rolled leaves.

Apple Leaf Skeletonizer (*Psorosina hammondi*)—An eastern insect most injurious in Upper Mississippi Valley but fluctuating in importance on apple, sometimes on plum or quince. The green fleshy part of leaf surfaces is eaten off entirely or in part, making the foliage look brown and dead and the tree as if it had been struck by fire. Leaves at end of branches or at top of the tree are often lightly folded and sometimes 2 or 3 are webbed together. The winter is spent as a brown pupa in fallen leaves; a dark-brown moth, wings mottled with silver, appears in late spring to lay eggs on leaves. First-generation caterpillars, brownish-green with 4 black tubercles on the back, ½ inch long, feed in June and July, then pupate on leaves, with second-generation larvae feeding in late August and September.

Control. The ordinary spray schedule, if it includes summer sprays for codling moth, will control leaf skeletonizers. In young or neglected orchards a separate lead arsenate spray may be needed.

Apple and Thorn Skeletonizer (*Anthophila pariana*)—A recently imported moth which has injured apple, thorn, and pear trees in New York and New England. Feeding is on upper leaf tissue under light webs and injury is chiefly on neglected trees. The moth is reddish-brown, the larva greenish, with brown head and black tubercles. There may be three generations.

Control as for apple leaf skeletonizer.

Birch Skeletonizer (*Buccalatrix canadensisella*)—Of fluctuating abundance in northern states, most common in New England, New York, Michigan, Wisconsin, Minnesota. Food plants are gray, paper, yellow, and European white birches, possibly alder. Chiefly a woodland pest, the birch skeletonizer may defoliate ornamental shade trees sometimes. The moths, ⅜ inch across the wings, brown with fore wings crossed with silver, fringed hind wings, appear in July to lay eggs singly on leaves. The young larva bores directly from the bottom of the egg into the leaf, mines in it 2 to 5 weeks, then cuts a crescent-shaped opening through the lower side of the leaf and spins a molting cocoon. After molting it feeds 1 to 9

days, spins a second molting cocoon, feeds for another week, then drops down to the ground and makes a brown, ribbed pupal cocoon for the winter. There is one generation a year.

Control. If this becomes a real pest of birch trees used as ornamentals, spray with lead arsenate in early August. At least ten parasites attack this skeletonizer.

Grape Leaf Skeletonizer (*Harrisina americana*)—Common on wild grapes, sometimes injuring cultivated varieties. The larvae feed in groups, side by side across a leaf, eating the upper surface only. Adults are small, smoky-black, narrow-winged moths.

The insect is so heavily parasitized that other control is unnecessary.

Hollyhock Leaf Skeletonizer (*Buccalatrix thuberiella*)—The larva of a small gray-and-tan moth mines in and completely skeletonizes foliage of ornamental hollyhocks in California.

Maple Trumpet Skeletonizer (*Epinotia aceriella*)—The leaves of red maple are folded loosely in August and September. The larva lives in a long, tapering, dark, trumpet-like tube near skeletonized areas, but the injury is more spectacular than serious.

Palm Leaf Skeletonizer—See **Palm Leaf Miner.**

Western Grape Skeletonizer (*Harrisina brillians*)—Present in Texas, New Mexico, Arizona. Black-and-yellow larvae feed on leaves of wild and cultivated grapes in late summer. They move in compact colonies as they completely skeletonize the leaves. Moths are metallic black or green.

LEAF TIERS

Leaf tiers are much like leaf rollers—caterpillars tying leaves together with strands of silk and feeding inside that protection.

Celery Leaf Tier (*Phlyctaenia rubigalis*), or **Greenhouse Leaf Tier**—Present throughout North America, a special pest of celery, feeding also on a great many garden and greenhouse vegetables and ornamentals—ageratum, anemone, aster, bean, beet, cabbage, carnation, cauliflower, cineraria, chrysanthemum, cucumber, dahlia, daisies, geranium, heliotrope, kale, Kenilworth ivy, lantana, lettuce, lobelia, nasturtium, parsley, passion vine, pea, sweet pea, rose, spinach, snapdragon, strawberry, thistle, violet, wandering Jew, to give a partial list.

Adult moths are brown, with front wings crossed by dark waxy lines, spreading ¾ inch. They are quiet during the day; fly at night. The female lays flattened, scale-like translucent eggs singly or in overlapping groups on underside of leaves usually close to the soil. They hatch in 5 to 12 days into pale green caterpillars, turning yellow when full-grown, ¾ inch

long with a white stripe down the back and a dark green line in the center of the white stripe. Young larvae have black heads. They feed on underside of foliage which is webbed together in large masses, and mine into stems and hearts of plants, especially celery. When disturbed they wiggle violently in their webs or drop to the ground. They pupate in silken cocoons inside the webs. The life cycle takes about 40 days and there may be seven or eight generations a year in greenhouses and five or six outdoors in warm climates. In Florida and in California this leaf tier is the major celery pest.

Control. For vegetables outdoors pyrethrum sprays or dusts are best. Two treatments, one 30 minutes after the other, are suggested. The first kills those worms hit and causes the others to leave the webs so they are caught with the second treatment. Recent recommendations for ornamentals in greenhouses call for spraying with tartar emetic or Salp as for gladiolus thrips. Cyanide fumigation will kill adult moths but not the caterpillars. For garden ornamentals a dust mixture of 85 parts sulfur to 15 parts lead arsenate is quite effective. Leaf tiers do not thrive in temperatures above 85° F. The hymenopterous parasite Trichogramma is also credited with keeping them reduced.

Figure 67

Hydrangea leaves fastened together by leaf tier, which is eating the flower bud enclosed

Hydrangea Leaf Tier—A small green caterpillar with a dark head sews tightly together terminal leaves of hydrangeas around the bud, making a sort of pocketbook. (Figure 67.) This very common insect either has not been described in garden literature or I have missed seeing the report, so I do not know its name. I do know that it is quite possible to tear open the pocketbooks, kill the small worm, and give the hydrangea a chance to flower. Arsenical sprays or dusts applied early enough give some control, but the leaves are usually tied together before one thinks to spray.

LIZARDS—See **Reptiles.**

MAGGOTS

Maggots are the larvae of flies. Some, commonly known by their adult name, have been treated under FLIES; those that normally go under the name of maggot are considered here.

Apple Maggot (*Rhagoletis pomonella*), or **Railroad Worm**—A native insect injurious to apples from the Dakotas east and Arkansas north. It probably fed originally on wild haws and wild crabs; now it eats apples, blueberries, European plum, cherries. A small variety of this species breeds on snowberry in the West, but there it is not an apple pest. (Plate XXVI, page 239.)

Hibernation takes place inside a small brown puparium buried 1 to 6 inches deep in the soil; but adult flies do not emerge until summer—late June in some sections, early July in most. They are a little smaller than houseflies, black, with white bands on the abdomen and conspicuous zig-zag black bands on the wings. The females lay their eggs singly through punctures in the apple skin; in 5 to 10 days these hatch into legless whitish maggots which tunnel through the fruit by rasping and tearing the pulp into brown winding galleries. Early varieties soon become a soft mass of rotten pulp; later varieties have corky streaks through the flesh and a distorted, pitted surface.

Completing their growth about a week after apples have fallen to the ground, larvae leave the fruit and burrow in the soil to pupate. Ordinarily pupation continues until the next summer, but in its southern range the apple maggot may have a partial second generation.

Control. A lead-arsenate spray (2 to 3 pounds per 100 gallons) after the flies emerge (July 1 to 7 in Connecticut), and a second 10 days later, are most effective, but will leave too much residue on early varieties in home gardens. A 90 to 10 sulfur-lead arsenate or lime-lead arsenate dust will leave less poisonous residue than the spray and is preferable on early apples. Rotenone dust at weekly intervals is entirely safe and may be effective.

Immediate removal and destruction of dropped fruit is helpful if a whole neighborhood co-operates, but a few neglected trees in a neighbor's yard may nullify individual effort. Maggots in picked fruit will be killed by holding apples in cold storage for a month.

Blueberry Maggot (*Rhagoletis pomonella*)—A form of the apple maggot and the most injurious pest of blueberries and huckleberries. Eggs are laid in ripe berries, maggots eat the pulp, and there is much fruit drop.

Calcium-arsenate and derris (rotenone) dusts give reasonable control.

Cabbage Maggot (*Hylemya brassicae*)—Introduced from Europe

more than a century ago; a serious pest in northern states, of little consequence south of Pennsylvania. Early cabbage after transplanting, late cabbage in the seedbed, early turnips, late spring radishes—these are most severely injured by maggots, but other crucifers—broccoli, Brussels sprouts, cauliflower, cress, mustard—may be infested, and sometimes beets, celery, and a few other vegetables. (Plate XXVII, page 270.)

Figure 68

Tar-paper square protecting cabbage seedling from maggots

The winter is spent as a pupa in an enclosing case, puparium, 1 to 5 inches deep in the soil. About the time sweet cherries bloom and young cabbage plants are set out, a small fly 1/4 inch long, dark gray with black stripes on thorax and black bristles, crawls out of the soil to lay white, finely ridged eggs at the base of the stem and on adjacent soil. These hatch in 3 to 7 days into small, white, legless maggots which enter the soil to feast on roots and stems just under soil surface, riddling them with brown tunnels. Seedlings wilt, turn yellow, and die. Maggot abundance fluctuates from year to year but often 40 to 80 per cent of young plants are lost.

After 3 weeks the maggot forms a puparium from its larval skin, producing another fly in 12 to 18 days. The number of generations is indefinite; ordinarily the first is important on cabbage and its relatives, while late broods menace fall turnips and radishes. In addition to its own feeding the cabbage maggot is credited with introducing the fungus causing blackleg disease.

Control. Protect seedbeds with a cheesecloth cover to prevent egg-laying. Place a 3- to 4-inch square of tar paper around the stem of each seedling when it is transplanted into the garden. (Figure 68.) The prepared

squares available at seed stores are usually too small, so cut your own, make a hole in the center with a nail, cut a slit from the middle of one side to the hole and place it around the seedling very carefully and flat on the ground. Do not let it get covered with soil in cultivating or the fly will lay her eggs too close to the stem.

If you prefer chemical to mechanical means, you can choose between: (1) ½ cupful of 1 to 2,000 dilution of bichloride of mercury (very poisonous) poured around each plant 5 days after setting and repeated twice at 5-day intervals; (2) dusting stems, between top roots and lower leaves, with 1 part calomel to 3 parts cornstarch before plants are set; (3) watering rows of radish with 1 ounce calomel in 5 gallons water, using 1 gallon to each 25 feet of row. In California dichlorethyl ether, obtainable in commercial preparations for lawn use, seems to be satisfactory for cabbage maggot control.

Cherry Maggot—See **Cherry Fruitfly.**

Onion Maggot (*Hylemya antiqua*)—A northern onion pest, only rarely injurious in the South. In dry years the onion maggot is of little importance, but in a series of wet springs 80 per cent or more of the crop may be destroyed, the larvae tunneling in bulb and crown so thoroughly that the onion dies or is worthless. One small maggot can kill a seedling onion. Early plantings are most injured.

The winter is spent as larvae or pupae in chestnut-brown puparia, resembling grains of wheat, several inches deep in soil or in piles of cull onions or other trash. The flies, gray or brown, large-winged, bristly, ¼ inch long, with 4 dark stripes on the thorax and a slightly humpbacked appearance, emerge in May and June, lay sausage-shaped white eggs at the base of plants or in cracks in soil. They hatch in 2 to 7 days; dirty-white cylindrical maggots, ¼ inch long, feed for 2 or 3 weeks behind leaf sheaths and in bulbs, then pupate in soil. There are two or more generations a year, a third generation often attacking onions just before harvest and causing storage rot.

Control. Practice clean culture and destroy all plant refuse in fall. Treat rows with bichloride of mercury or calomel as for cabbage maggot. An easier method is to treat seed with calomel before planting, using 2 parts by weight of calomel to 1 part of seed which should be previously moistened with a little gum-arabic solution so that the calomel will adhere to the seed. Treat just before planting. An old method, still satisfactory but probably better adapted to commercial culture than the home garden, is spraying the tops with a mixture of lubricating oil in bordeaux mixture, using 1 part oil to 30 parts spray.

Pepper Maggot (*Spilographa electa*)—First noticed in New Jersey in 1921. Most serious injury is to peppers but eggplant may also be

infested. The adult is a barred-wing fruitfly which lays eggs on young peppers in late June. Young maggots, white, nearly headless grubs up to ½ inch long, feed on the core and spoil the fruit. Pupation is in soil; there is one generation.

Control. Keep pepper fruits thoroughly dusted with talc during July and early August when flies are laying eggs. This keeps the females from getting a foothold on pepper skins for ovipositing. Leaving a few peppers for a trap crop and harvesting early are other suggested procedures.

Raspberry Cane Maggot (*Pegomya rubivora*)—A northern insect found from coast to coast on blackberry, dewberry, loganberry, raspberry, rose. The tips of new shoots wilt, sometimes with a purplish discoloration at base of wilted part, or are broken off clean as though cut through with a knife. Sometimes gall-like swellings are formed in canes. The maggots are white, ⅓ inch long, and tunnel down in the pith after they have girdled the cane and caused the break. Pupation is in canes with flies, similar to houseflies but half the size, emerging in spring to lay eggs in leaf axils of tender shoots.

Control. Prune off infested tips, cutting several inches below wilted portion.

Seed-corn Maggot (*Hylemya cilicrura*)—A European insect which arrived here nearly 100 years ago and is distributed over most of the United States. Chief injury is to germinating seed, with peas and beans often more seriously injured than corn; with melon, cucumber, potato sprouts often killed; and young plants of cabbage, beet, bean, pea, onion, potato, turnip, spinach, radish, sweet potato frequent victims. The maggot even causes effects similar to damping off on coniferous seedlings, according to a report from western Washington.

Yellow-white maggots, ¼ inch long, sharply pointed at head end, burrow in seed, so that it either fails to sprout or produces a weak, sickly plant. Injury is worst in cold, wet seasons on land rich in organic matter. The winter is spent in puparia in soil or as free maggots in manure. Grayish-brown flies, ⅕ inch long, emerge in early July to deposit eggs in rich soil or on seeds or seedlings. There may be three to five generations.

Control. The easiest way of dealing with this pest is to replant when the ground is warm enough to allow quick germination and rapid growth.

Squash Root Maggot (*Muscina assimilis*)—A European species present in many parts of the country. It is common in partly decayed vegetables, but also on occasion mines and destroys roots of young squash plants. It is probably more helpful than harmful, since it is reported as a predator and parasite on caterpillars.

Sunflower Maggot (*Strauzia longipennis*), also known as **Sunflower Peacock Fly**—Present in many parts of the country, infesting stems of

wild and cultivated sunflowers. The flies are a gay yellow, the female having an orange ovipositor and the male a tuft of black spines on its head.

Walnut Husk Maggot—See **Walnut Husk Fly.**

MAMMALS

A group of miscellaneous warm-blooded animals are, at times, garden pests. They are not all rodents (squirrels, rats, mice, rabbits, and other animals characterized by chisel-like teeth for gnawing), and some of them are as useful as they are destructive. As mammals their young are born alive, they possess mammary glands and suckle their young; they have hair, even though it may be so modified as to be almost unrecognizable, the body is kept at constant temperature regardless of the temperature of the environment.

Armadillos—Burrowing, chiefly nocturnal mammals of tropical America and the South, having the body encased in an armor of small bony plates, many capable of rolling into an armored ball when disturbed, giving birth to identical quadruplets. Armadillos eat insects, snails, worms, small reptiles, sometimes carrion, but often their burrowing is as distressful to Florida or Texas gardeners as that of woodchucks in the North.

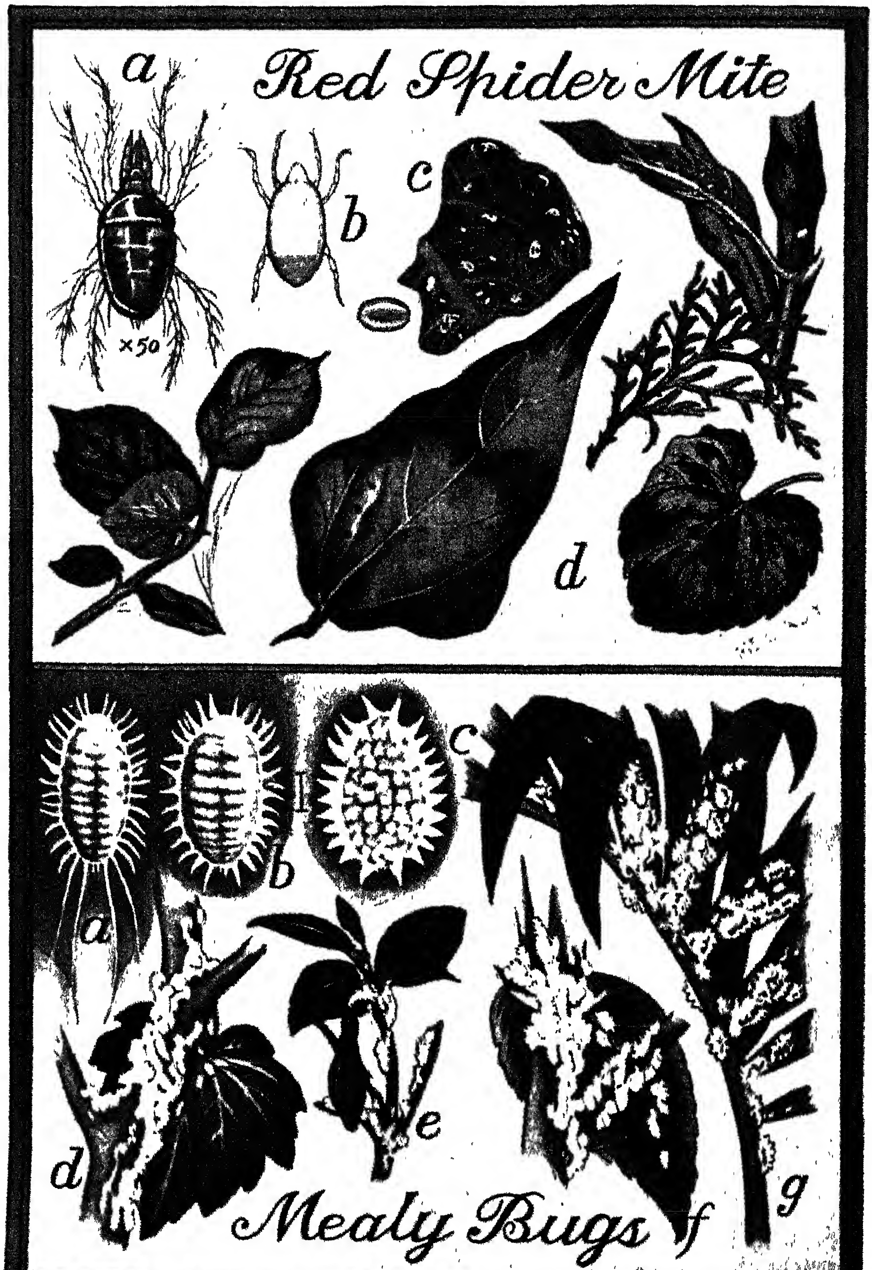
Control is difficult. Try a 2-foot fence of chicken wire around the garden, as for rabbits, or place rabbit traps across their paths, or, as a last resort, shooting, if permitted in your locality.

Cats—Carnivorous mammals long kept by man as pets or for catching rats and mice. That's the dictionary definition, implying that cats are generally useful members of a community, but people are seldom dispassionate about cats. Some are cat lovers, some are violent cat haters. Except in small city gardens, where a lot of cats congregate and dig, cats do little damage to garden plants and are very useful in keeping down the population of field mice, moles, and baby rabbits. Their chief offense is against birds, and although cats vary, some of them being pretty lazy, there is hardly any cat blameless in this respect.

Belling a cat helps some, and keeping a cat indoors in the early hours of the morning helps a lot. Every cat owner should take these two precautions.

Personally, I like to have a cat in the house; it really is good company, despite all cartoons on the subject, for a spinster living alone, and it does keep an old house free of mice and rats. But when I have a cat I keep it belled, I try to keep it in nights, and I never, never encourage the birds by feeding them. In recent years I have decided that birds are more fun

XXVII **CABBAGE WORM: (a)** adult butterfly; **(b)** full-grown worm (larva); **(c)** egg (magnified 10 times); **(d)** chrysalid attached to leaf; **(e)** typical injury to cabbage head by larvae and adults laying eggs. **CABBAGE MAGGOT: (a)** adult fly; **(b)** legless maggot (much enlarged); **(c)** maggots working on roots; **(d)** fly laying eggs at base of stem; **(e)** puparium in soil.



XXVIII **RED SPIDER MITE** (See COMMON RED SPIDER): **(a)** adult 8-legged mite (magnified 50 times); **(b)** young 6-legged larva or nymph; **(c)** egg, enlarged, and mites in web on underside of bean leaf; **(d)** typical spider-mite injury and discoloration of phlox, cedar, rose, bean, violet. **MEALYBUGS.** **(a)** LONG-TAILED MEALYBUG; **(b)** CITRUS MEALYBUG; **(c)** PALM MEALYBUG; **(d)** mealybugs on begonia; **(e)** on fuchsia; **(f)** on coleus; **(g)** on palm.

than a cat, so I have company on the outside window sill rather than curled up on the indoor window ledge. I don't think it's fair to try to have both, any more than it is fair for bird lovers to try to have all cats abolished.

Chipmunk—A small striped rodent, one of the ground squirrels. For one so small and so engaging, the chipmunk is a good deal of a garden pest, tunneling under shrubs and upsetting their root systems, and ruining bulb plantings. The best protection for bulbs is to plant them in wire baskets. Some gardeners place naphthalene flakes in the soil around bulbs when planting, but this is risky business. I have seen bulbs, many of them, that did not grow at all and others badly stunted from using a little too much naphthalene too close.

Dogs—Most everyone likes dogs, but not many people care to have brown patches on their front lawns or the border shrubbery dying because of dogs. The first step in dog control is owner education. Owners should keep their dogs curbed, as required by some city ordinances, and not allowed to investigate shrubs and lawn areas. In communities where dogs are allowed to run loose, wire shrubbery guards, almost invisible wires sharpened to a point and bent out at the right angle, will, when placed 3 or 4 to a bush, give almost complete protection.

There are a great many dog repellents on the market, all of which probably have some effect for a short period. Nicotine is supposed to be a dog repellent, but whenever I spray with Black Leaf 40 and soap dogs always follow me around gardens.

BB shot, enough to sting but not to injure, seems to be a favorite way for gardeners to teach neighbor dogs to stay away. A barberry hedge is effective, and so are a few cut twigs of barberry dropped along a path usually followed by dogs.

Gopher—A burrowing rodent, the size of a large rat, with small eyes, short ears, strong claws on the forelegs, a short, nearly naked tail, and large cheek pouches which give it the common name of pocket gopher. The term gopher is also used in Florida to mean a land tortoise, and sometimes in the Middle West for land squirrels.

Gophers are widely distributed in California, there being more than 30 species in different geographic areas, and they are present through the Middle West, but they are not an eastern problem. They dig clean-cut, round tunnels parallel with the surface of the ground and 8 to 24 inches below it, throwing out rounded surface mounds of earth at intervals through short lateral tunnels, and making other laterals to feed on surface vegetation. A single gopher may make 100 yards of tunnels. Meadow crops, truck crops, and ornamentals, especially those with bulbous roots, are injured, roots of trees and vines are cut, and trees

girdled. In irrigated gardens gopher burrowing may divert the water elsewhere.

Gophers can be controlled by trapping with a special gopher trap set in the main runway, or by poison bait. To make the latter, cut carrots, parsnips, or sweet potatoes into pieces ½ inch square by 1 inch long and sprinkle with powdered strychnine at $\frac{1}{32}$ ounce (about 1 gram) to a quart of bait. Poke holes in the runways with a stick, drop in 2 or 3 pieces of bait per hole, and close openings with soil.

Trapping or poisoning works best in early spring. Some states pay a bounty on gophers.

Groundhogs—See **Woodchucks.**

Ground Squirrels—Burrowing rodents who find most of their food on the surface of the ground and dig burrows in flat, open country or in hillsides. One type, the California or digger squirrel, even climbs trees in search of nuts and fruit, destroys crops, carries disease, injures irrigation structures. The Oregon ground squirrel does not climb, but it eats seed and injures plants in other ways.

In Iowa the striped or thirteen-lined ground squirrel is found in all parts of the state, a seed-feeder, digging up planted corn, soybeans, melon, but also an insect-feeder, destroying crickets, grasshoppers, caterpillars. The Franklin or gray ground squirrel measures 17 inches from nose to tail, digs up seeds over a wide area, often making it necessary to replant a whole cornfield; but it, too, eats insects.

Ground squirrels have quite a long period of hibernation, or estivation, as some in California go into a torpid period in August or September which may last until February or March. In Iowa hibernation may be from October to April. Young are born in the spring, and females should be killed or poisoned early in spring before they reproduce. There are several ways to fight ground squirrels, but poisoning with strychnine seems preferred. The Government Formula calls for:

16 qts. barley (clean whole grain) for California ground squirrel (substitute 20 qts. oats for Oregon and other species)
1 oz. strychnine (powdered alkaloid)
1 oz. bicarbonate of soda (baking soda)
¾ pint thin starch paste
¼ pint heavy corn syrup
1 tbsp. glycerine
$\frac{1}{10}$ oz. saccharine

Mix strychnine, soda, and saccharine together dry. Prepare starch paste by dissolving 1 heaping tablespoon dry gloss starch in a little cold water, pour into ¾ pint hot water, boil, and stir until clear. Add the dry mixture, then the syrup and glycerine, stir well, and pour over grain,

turning and stirring until each kernel is coated. Spread out in a thin layer to dry, then store in a can labeled POISON. Put the bait inside burrows, away from birds and other animals. Dogs eating poisoned ground squirrels may be killed.

Fumigation is safer for the pets. Soak a wad of cotton with carbon bisulfide and place it in the burrow or pump in carbon bisulfide with a special machine called Karbo Killer or Demon Rodent Gun. Calcium cyanide can be used but seems to be less satisfactory.

Trapping, using the Oneida jump trap, or shooting is recommended for small numbers of squirrels. Fruit and nut trees can be protected with smooth cylinders of tin around the trunks. Seed corn can be protected by treating with coal tar—1 large spoonful added to a gallon of boiling water and then cooled.

Ground squirrels have many natural enemies—coyotes, badgers, weasels, wild cats, red-tailed hawks, golden eagles, rattlesnakes, and gopher snakes. No one wants to protect rattlesnakes, but it would be a shame to kill gopher snakes.

Hedgehogs are not found in this country, but the name is sometimes applied to our native porcupines. The latter eat insects and are not garden pests.

Mice are destructive rodents in the garden as in the house. The house mouse, deer mouse, meadow mouse, pine mouse, and others are loosely grouped together under the term field mice and are particularly dangerous to plants in winter, in uncultivated orchards where there is a tangle of weeds and tall grass, and in gardens where winter protection for plants means also a cozy winter home for mice. Most mice live both in and on the ground, constructing surface runways in grass which connect with burrows in soil.

The pine mouse works entirely in the ground, burrowing from a few inches to several feet below the surface and injuring, sometimes killing, orchard trees, nursery stock, small fruit, shrubbery, azaleas, camellias, gardenias, and very frequently roses, by cutting off the roots. Other mice work on the surface of the ground, under cover of salt hay, straw, leaves, or burlap, and girdle canes or young trees by gnawing off the bark.

Mice can be controlled either by snap-back mouse traps placed in runways or by poison bait, either starch-coated grain (recipe given under ground squirrels) or with a strychnine-soda mixture made as follows:

Mix together, dry, 1/8 ounce powdered strychnine and 1/8 ounce baking soda; sift over 1 quart of oats; stir; warm in an oven, and pour over them 6 tablespoons of a mixture of 3 parts melted beef fat and 1 part melted paraffin. Stir until oats are evenly coated.

Place portions of the bait in runways or in special containers so that

birds and pets cannot reach the poison. One method of placing bait is under 18-inch squares of cheap roofing paper placed on the ground over a runway and held down with earth or straw. The mouse will soon make its run under the cover and then a few poisoned grains can be dropped in by lifting one corner of the paper.

Protect young trees with wire guards as recommended for rabbits.

Moles are not true rodents, since they do not have chisel teeth. They belong to the Insectivora, or insect-eating group, but they may ruin lawns with their extensive ridged tunnels just under the surface and they sometimes kill garden plants by burrowing through the roots.

There are 5 groups of moles in the United States. The large western Townsend mole and the eastern star-nosed mole make large mounds, the common eastern mole does not. They may feed on seeds and bulbs to a limited extent, but more often the injury is from mice using the mole runs for their pathways. Moles produce one litter, with 3 or 4 young, each year.

Trapping is considered the surest way of killing moles. Several types are available—the scissors jaw, choker loop, or diamond jaw, which grip the animal, or the harpoon type, which kills by piercing the body with a prong. The latter is favored for small eastern moles, and is set by packing down the runway ridge and pressing down the trap across the runway. The other types are set by digging a hole across the burrow the width of the trap.

Other mole remedies are the insertion of paradichlorobenzene or lye or naphthalene flakes into the mole run every 8 to 10 feet, or gassing with carbon bisulfide, Cyanogas, or with carbon monoxide applied with a hose attached to the exhaust pipe of an automobile. Commercial poisons are not considered very satisfactory, but I have had a little success with Mole-Nots.

If you see the earth heave while working in the garden you can usually kill the mole with a spade or pronged instrument. The most efficient mole eliminator I have ever seen was a cat, and I have read about others. Not all cats are satisfactory, but when you get a really good moler she will kill 1 or 2 a day and after cleaning up your garden will start bringing moles home from neighboring areas.

Rabbits remain the big animal problem when it comes to raising vegetables, and despite dozens of remedies offered in the past few years the best is still a fence of 1- to 1½-inch chicken wire, stretching at least 24 inches high (36 is better) and nearly 6 inches into the ground. Wartime substitution of tarred paper for a fence was only partially satisfactory.

Repellents which sometimes work for rabbits include:

1. Moth balls scattered along the rows of plants; easy and effective in many cases. They usually work in my garden.

2. Dried blood dusted on plants at rate of 8 ounces to 25 linear feet of row.

3. Powdered alum, 2 tablespoons mixed with 4 cups wheat flour, applied as a dust.

4. Powdered alum, 2 ounces mixed with 1 pound tobacco dust, applied as dust.

5. Aluminum sulfate, 4 teaspoons, plus hydrated lime 5 tablespoons to 1 gallon of water, used as a spray. Wash off residue before eating greens.

6. Dusting plants liberally with powdered lime when they are wet.

7. Dusting liberally with dusting sulfur.

8. Sprinkling plants with red pepper.

9. Spraying with a solution of 3 ounces Epsom salts to 1 gallon water.

10. Spraying with 2 teaspoons Black Leaf 40 to 1 gallon water. Permits to trap or shoot rabbits can often be obtained from your State Board of Fish and Game Commissioners, but since many communities have ordinances against use of firearms, local permission must be obtained as well.

Protect trees from rabbits and mice by a cylinder of close-mesh woven wire, sunk into the ground a few inches, held away from the trunk with stakes except at the top, where it is bent in to touch the trunk. Some composition material can be substituted for the wire.

As already suggested, cats are a great help in killing baby rabbits.

Rats are found in exclusive suburbs as well as in city warehouses and on farms. Kitchen garbage added to the compost pile will attract rats unless it is immediately covered with a thick layer of earth. Rats will eat plants and seed, in house or greenhouse, and of course they are dangerous as disease carriers. The new miracle rat killer 1080 is apparently too dangerous for amateur use and should be applied by experts. The amateur can, however, safely use Red Squill, for if domestic animals get the poison by mistake it acts as an emetic. Rats cannot vomit, and so must retain the poison and die. It is mixed with cereals, meat, apples, or bananas for bait, according to the food preference of rats in each section.

Skunks are moderately helpful, in that they live partly on insects and mice; but they also eat birds' eggs, and when they go after grubs in lawns they leave fairly conspicuous holes.

Squirrels, the tree types, seem particularly obnoxious to some gardeners. Admitted that they eat corn, wreck pears just to get the seeds, eat up sunflower seed put out for birds, sometimes rob birds' nests, some-

times get into houses—still they are a natural part of the garden picture and I, for one, would not have them shot, even if shooting were permitted in my town. In fact, it is the antics of Peter, the gray squirrel who adopted me some years ago, that are keeping me sane while I spend day after day glued to the typewriter. A couple of weeks ago I moved my writing paraphernalia to an upstairs room that was warmer than my office. Peter arrived on the outside window sill a few minutes later and informed me in no uncertain terms that if I were staying upstairs he would have his meals at that window rather than at the bird feeder out in the yard. So I put food out for Peter and his wife, and inside of 24 hours the juncoes, chickadees, whitethroats, and a pair of cardinals were all feeding just outside the glass, scarcely a foot from my elbow. I'm very grateful to Peter for bringing the birds a little closer than I've ever had them before, and they don't seem to resent him in the least.

If you don't want to feed the squirrels along with the birds you can suspend the feeding station on a wire and have great metal guards fore and aft. Squirrels will always go after corn, but in my garden they divide with me; if I leave them the outside rows they let me have the rest. They are much more polite than the blackbirds, which leave me nothing at all once they find my corn patch. As for pears—mine are those hard Kieffers, and after the neighbors and I have stewed and canned more than we want there are plenty left for the birds and squirrels. Yesterday Peter collected an old frozen pear he had cached somewhere and lugged it all the way up through the intricate network of branches it takes to reach the upstairs window sill. Maybe because it was warm in the sun, maybe he just wanted company. We are all friends—Peter and the birds and I.

Woodchucks, or **Groundhogs,** the largest of the rodents, burrow in gardens and feed on vegetation near their burrows. They can be killed with carbon bisulfide, about 3 tablespoons poured on a wad of cotton and thrust down into a burrow, which is then closed, or with 1 to 2 tablespoons of Cyanogas placed deep in the burrow with a long-handled spoon. The former is more effective if the burrow is damp, the latter in dry weather.

The United States Fish and Wildlife Service has developed a special woodchuck cartridge, obtainable through county agents, which can be placed in the mouth of a den, lighted, and will diffuse a lethal gas through the burrow.

MANTIDS

The praying, or preying, mantis and its relatives are very definitely our friends in the garden. They belong to the grasshopper order, Orthoptera, and the family Mantidae. They are all predaceous on other insects, capturing their prey with marvelous front legs, long and muscular, fitted with grooves and spines for grasping and holding. While waiting for some unwary insect they sit in an attitude of prayer.

Baby mantids, looking ridiculously like their elders except for wings, are cannibals from the day they are born. They start with aphids, or perhaps one another, going on to larger insects as they grow. A full-grown praying mantis is not afraid to strike at a frog, a lizard, or a hornet.

There are about 20 species known in North America. Three are common in the East.

Carolina Mantis (*Stagmomantis carolina*)—A native, found as far north as southern New Jersey, Pennsylvania, and Ohio. It has uniformly green wings, is about 2½ inches long.

Chinese Mantis (*Tenodera sinensis*)—The common form in Middle Atlantic states. It was introduced from Asia into Philadelphia about

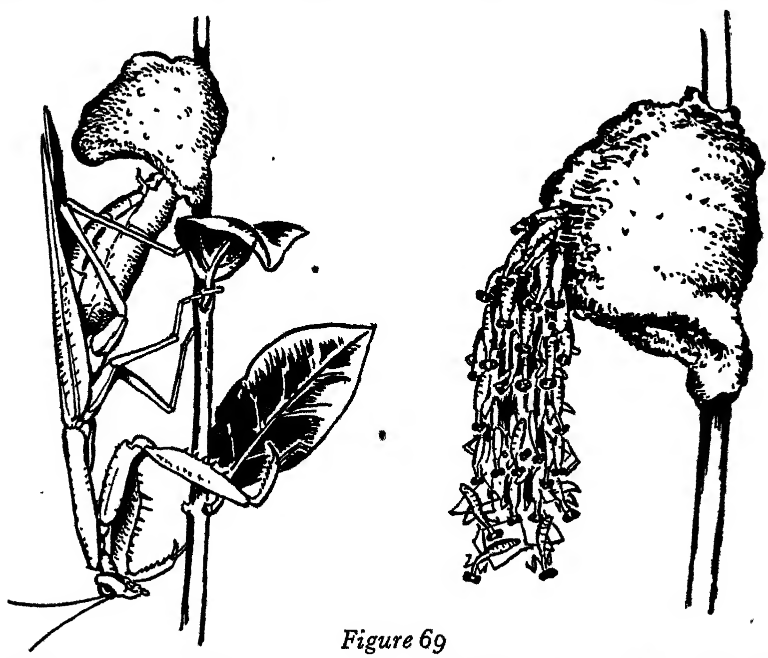


Figure 69

Praying mantis making her egg mass as she hangs head down, and young mantids emerging. (Drawn from photograph by Teale)

1896 and has since spread to Ohio and southern New England. It is large, 3 to 4 inches long, and the broad green front margin of the wings is sharply separated from the larger brown portion. The egg mass is shaped like a short, broad cornucopia of dried foam.

European Mantis (*Mantis religiosa*)—Found in 1899 near Rochester, New York, and established in that section. It is a little larger than the Carolina mantis but resembles it.

A number of other species are found in the West, but they all look and act much alike.

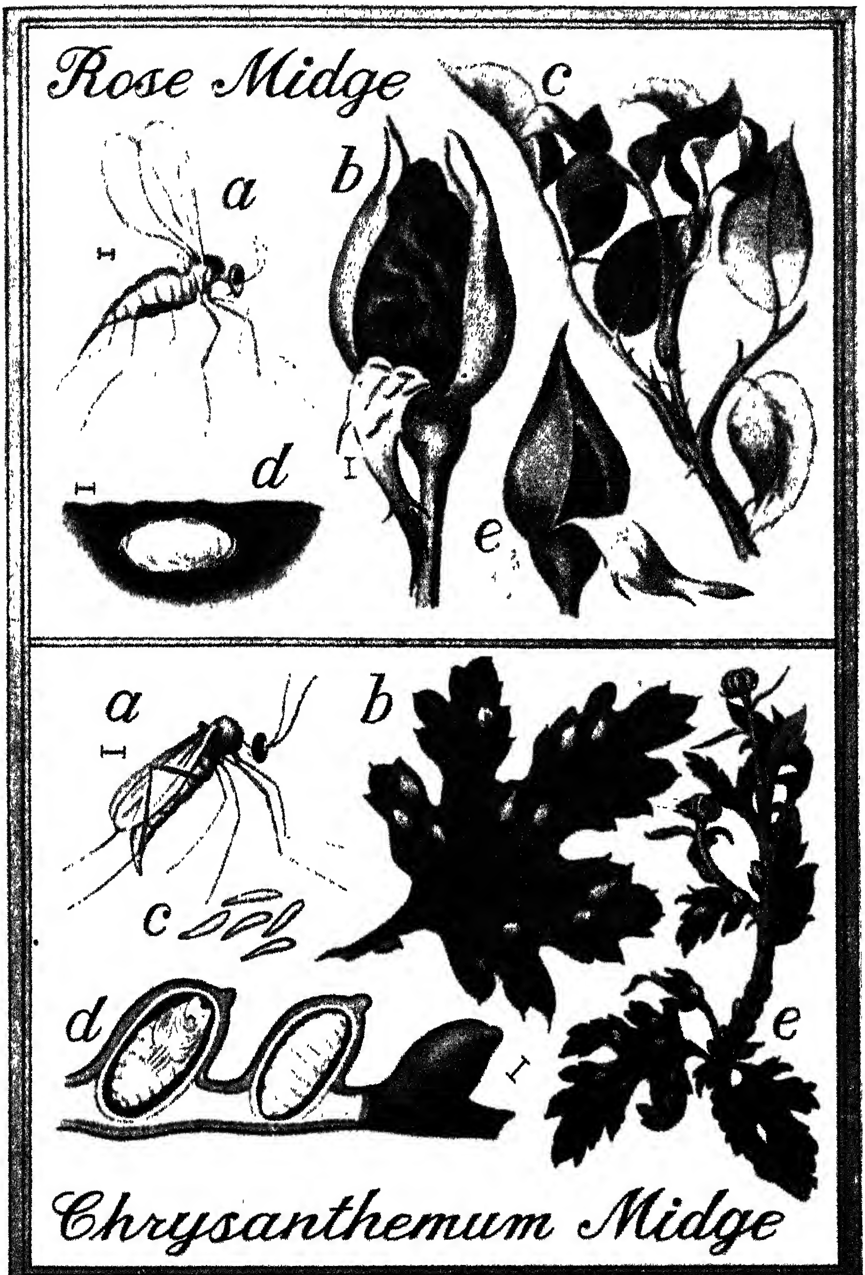
Figure 69 shows a female in the act of laying her eggs and the egg mass itself, drawn from the remarkable photographs of Edwin Way Teale. Mr. Teale watched a female for 3 hours, hanging head down, producing a gummy fluid "like toothpaste from a tube" and beating it into froth the color of ripe grain. Never once did she look back to see what was happening, and when the operation was finished she moved on with never a backward glance.

These egg masses or cocoons are made up of a series of plates providing chambers for 100 or more eggs, and they may be attached to any shrubs or grasses about the garden. Learn to recognize them so as not to cut them off during pruning. If one is inadvertently cut, tie it back in place. The egg masses winter to a deep unnoticeable chocolate color and when the young appear in spring they hang down over each other like a bunch of bananas. They are scarcely noticed all summer but when they reach adult size in August and September they are commonly seen in gardens. I often have to shoo them away from plants I want to spray. The male is slender and is sometimes devoured by the female after mating.

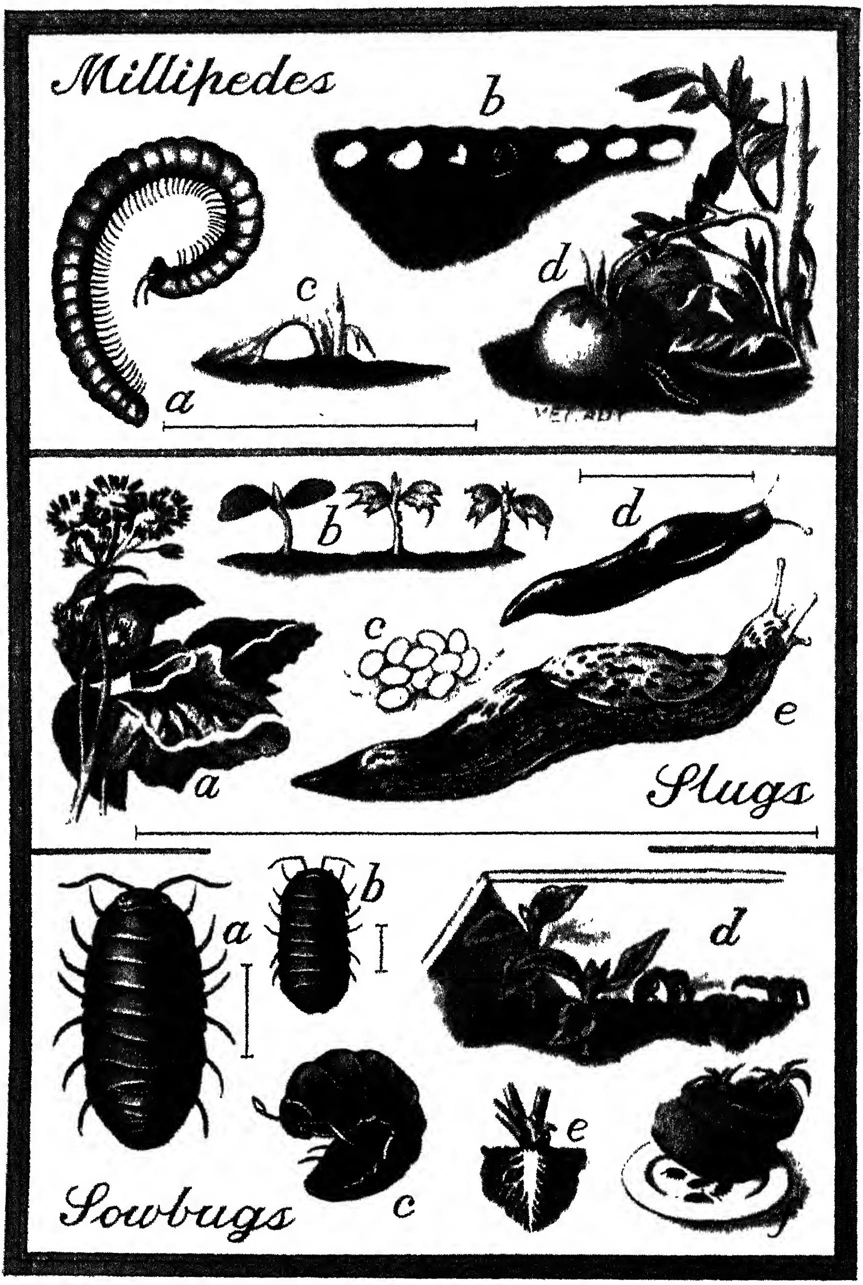
Praying mantids are given credit for cleaning up Japanese beetles, but I think they are more useful against other insects. They are fun to have around, with their great big eyes following your every movement, and make appealing house pets for their short lives. I kept one on a spray of goldenrod in my office one September. She disappeared to lay her eggs and I never did find the cocoon until Christmas Eve when the babies started marching down the curtain and across my desk. But that was a waste of mantids, since I could not feed them enough insects to keep them alive until spring.

MEALYBUGS

Mealybugs are relatives of scale insects, members of the family Coccidae, order Homoptera. They are small, oval, soft insects with their bodies covered with white powdery wax extending in filaments beyond the body. In most species, the short-tailed mealybugs, these filaments are



XXIX **ROSE MIDGE:** **(a)** adult; **(b)** larvae on inside of sepal, and injury to bud; **(c)** distortion of young shoot; **(d)** pupa in cocoon in soil under rosebush (enlarged); **(e)** egg mass in position on bud sepal and eggs magnified. **CHRYSANTHEMUM MIDGE:** **(a)** adult (much enlarged); **(b)** conical galls on leaf; **(c)** eggs (magnified); **(d)** chrysanthemum stem with galls cut to show pupa and larva or maggot inside; **(e)** shoot with galls on stem and leaves.



XXX **MILLIPEDES:** **(a)** millipede somewhat enlarged to show 2 pairs of legs on each segment and in typical coiled position; **(b)** seeds injured by millipedes; **(c)** injury to young seedling; **(d)** tomato attacked when resting on ground. **GIANT SLUG:** **(a)** slimy trail on cineraria; **(b)** seedlings eaten by slugs; **(c)** egg cluster; **(d)** 30-day-old slug; **(e)** mature form with spots. **SOWBUGS:** **(a)** adult; **(b)** young sowbug; **(c)** common form, known as pillbug, with habit of rolling into a ball; **(d)** infested seedlings; **(e)** sowbugs working at roots; **(f)** favorite hiding place under moist flowerpot.

of equal length all around the body, but in 1 species, the long-tailed mealybug, there are long threads at the posterior end of the body in addition to the short filaments around the sides.

Most mealybug species are able to live outdoors over winter only in subtropical regions, becoming house or greenhouse pests in the North. There are, however, 1 or 2 species, such as Comstock mealybug and Taxus mealybug, which winter out-of-doors as far north as New York and Connecticut. Mealybugs injure plants by sucking sap and by producing copious honeydew which attracts ants and forms a medium for growth of sooty mold fungi. Some species are known to disseminate plant-disease organisms.

The life history of most mealybugs is about the same. The adult female deposits her eggs, 300 to 600, in a compact, waxy sac beneath the rear end of her body. Egg-laying continues for a week or two, then the female dies. These conspicuous egg sacs, doubtless well known to anyone who has grown house plants, are found chiefly at axils of branching stems or leaves but sometimes on other plant parts. Indoors, eggs hatch in about 10 days; the young mealybugs remain in the case for a short period, then crawl over the plants. As crawlers they are oval, light yellow, 6-legged insects with smooth bodies, feeding like aphids by inserting their beaks into plant tissue and sucking out the sap. Soon after feeding begins waxy filaments start forming, covering the bodies and radiating out in 36 leg-like projections. The bugs get more sluggish but do not entirely stop moving. The female adult is much like the nymph, and 1/6 to 1/4 inch long, but the male forms a white case within which it changes to a minute, active, 2-winged insect looking like a fly. It mates with the female and dies soon after, being unable to feed in the winged state. In favorable temperatures the life cycle is completed in one month.

The long-tailed mealybug differs in its life history by giving birth to living young instead of forming an egg sac. (Plate XXVIII, page 271.)

Mealybugs indoors are usually controlled with oil sprays; outdoors much reliance is placed on biological control. The mealybug destroyer (*Cryptolaemus montrouzieri*) is a beetle predator introduced into California from Australia in 1892. Since it did not thrive too well when left to itself outdoors, artificial propagation was started in 1916, using potato sprouts for mass production of beetles. For many years it was remarkably efficient in cleaning up mealybugs in citrus orchards, but in 1929 two Australian parasites (*Coccophagus gurneyi* and *Tetracnemus pretiosus*) were liberated in orchards, establishing themselves so successfully that it was possible to give up the expense of rearing *Cryptolaemus*. There are many other parasites for various mealybug species, and in Florida there is also a fungus which works on the citrus species.

Azalea Mealybug (*Eriococcus azaleae*)—Native of Japan, common on outdoor azaleas in the South. Cottony masses, enclosing dark red females and their eggs, are present in forks of branches and over twigs. The males have a similar white covering but are smaller and more elongate.

Reddish-brown crawlers hatch in 3 weeks with females mature in about 100 days. In summer the life cycle is complete in 130 days, in winter in 250 days. Usually the winter is spent as nymphs with females maturing and starting to lay eggs in March, in Alabama, nymphs hatching in April, and a second generation coming along in September. Infested azaleas look most unthrifty and are covered with black sooty mold.

Control. Spray for the nymphs with Florida Volck, at the rate of 3 level tablespoons plus 2 tablespoons powdered derris and 1 teaspoon Black Leaf 40 to a gallon of water. In using Nursery Volck increase the amount to 4½ tablespoons. Make the first treatment toward the end of May and the next at the end of September. A parasitic wasp reduces mealybug infestations but is not sufficient control.

Citrophilus Mealybug (*Pseudococcus gahani*)—First observed in California in 1913. It attacks apple, azalea, blackberry, citrus, climbing fig, cherry, columbine, cyclamen, English ivy, eugenia, foxglove, heliotrope, mallow, Mexican orange (Choisya), mustard, nightshade, peach, pear, pittosporum, plum, prune, potato, pepper tree, privet, raspberry, rhubarb, rose, grevillea, sunflower, walnut. It thrives in the cool coastal areas, is not amenable to fumigation, but has been kept under control first by *Cryptolaemus* and more recently by the Australian parasites. It differs from the citrus mealybug in having 2 long, tapering filaments at the end of the body and about a third the length of the body, and with the waxy coating scarce in 4 areas which look like 4 longitudinal lines.

Citrus Mealybug (*Pseudococcus citri*)—Distributed throughout the world in greenhouses and outdoors in subtropical climates. It is such an omnivorous feeder that it is impossible to list all the host plants. As a greenhouse and house-plant pest it is especially troublesome on soft-stemmed foliage plants such as African violet, coleus, begonia, fern, fuchsia, is almost always present on gardenia, readily infests amaryllis, avocado, bignonia, camellia, crassula, cineraria, cycas, cactus, chrysanthemum, croton, daphne, dracaena, heliotrope, ivy, lantana, oleander, orchids, poinsettia, rubber plant, umbrella plant, yucca. It is an outdoor pest of citrus trees in California and Florida, known since 1879, and in Florida troublesome on sprouts of spring-grown potatoes kept through the summer for planting the fall crop. In southern California the citrus mealybug is found in the open on most of the plants mentioned above and also on bottlebrush, bouvardia, palms, moonflower, passion flower, plumbago,

strelitzia, and wandering Jew. It is known to live outdoors in Arizona and New Mexico but is not much of a pest there.

The white powder over the back of the citrus mealybug is very dense, and the filaments are about equal length all around the body.

Control. A few mealybugs on house plants can be picked off with a toothpick, or killed with a small cotton swab dipped in alcohol. Forceful syringing with pure water will often dislodge mealybugs from such plants as can stand it. Greenhouses not attached to dwellings can be fumigated, at frequent intervals, with Cyanogas. When the young are in the crawling stage nicotine-sulfate or thiocyanate sprays are fairly satisfactory, but for stubborn infestations treatment with a white oil emulsion, such as Volck, is necessary. Follow manufacturer's dosage directions for particular plants, keeping them out of direct sun during and after treatment, and syringing off with pure water several hours later.

Ants, with their fondness for sweet honeydew, often carry mealybugs from plant to plant. Control the ants and keep plants spaced far apart. In citrus orchards take special precautions against the Argentine ant.

Natural enemies play a most important part in mealybug control. Insect parasites and predators can be obtained from state insectaries. A Sicilian mealybug parasite introduced into California in 1914 and specific for the citrus mealybug is probably responsible for the fact that this mealybug is now less injurious than the citrophilus mealybug.

Comstock Mealybug (*Pseudococcus comstocki*), also known as **Catalpa Mealybug**—A Japanese pest widely distributed from Massachusetts, Connecticut, and New York south to Florida, known in Ohio, Indiana, Louisiana, and reported in California. One of the few mealybugs to live outdoors in temperate climates, it feeds on apple, boxwood, catalpa, holly, horsechestnut, magnolia, maple, mulberry, osage orange, poplar, Monterey pine, and weigela. It has been known as a serious pest of umbrella catalpa for some time but has been actively injurious to apple only in the past 10 or 12 years in Virginia, 5 years in Connecticut.

The Comstock mealybug seems to be most serious in apple orchards thoroughly sprayed for other pests. In addition to the injury from sap-sucking, the fruit is greatly disfigured with sooty mold growing in honeydew, often coincident with a soft rot. When the mealybugs congregate at a split in the tree or at a pruning scar, knot-like galls are formed.

Eggs winter in bark crevices, hatching when leaves are about an inch long in spring. This mealybug has 2 longer filaments at the end of the body. Reproduction is rapid; there are three broods in Virginia, probably two in Connecticut.

Control. Insecticides seem not very efficacious; chief dependence is on parasites, 2 of which are naturally established in orchards. One of them

is, unfortunately, attacked by secondary parasites, but the other is prolific, as many as 25 coming from eggs laid in a single mealybug. In addition there are some imported Japanese parasites getting established in orchards, and a fungus which kills large numbers of bugs, although its performance varies with the season.

On catalpa and other ornamentals some control is obtained by cleaning all old leaves from the trees and brushing out mealybugs from crotches and crevices with a stiff brush. Thorough washing of trunk and branches with the hose is helpful, as is spraying with nicotine sulfate and soap. Sometimes a dormant spray of oil or lime-sulfur is used.

Cypress Mealybug (*Pseudococcus ryani*)—Present throughout California. It is most common in Monterey cypress, but also feeds on other species and on arborvitae, araucaria, Norfolk Island pine, incense cedar, redwood. This species has short lateral filaments and a pair of tail filaments one third to one half the length of the body.

Golden Mealybug (*Pseudococcus aurilanatus*)—Introduced into California from Australia and New Zealand on Norfolk Island pine and the monkeypuzzle tree. It is common in southern California and is found as far north as San Francisco. The body is reddish-purple, covered with yellow wax. Eggs are purple in a yellow sac. Its natural predator in Australia is the *Cryptolaemus,* which was introduced into California to control citrus mealybugs.

Grape Mealybug (*Pseudococcus maritimus*)—Another omnivorous feeder, but mostly underground. It was originally found on the roots of buckwheat in California, occurs naturally on roots or tops of clover, elder, buckeye, willow. From these it has gone over to cultivated plants, including apple, century plant, California poppy, coleus, columbine, Canary date palm, carnation, grevillea, lima bean, English ivy, ginkgo, European grape, laburnum, lemon, orange, Mexican orange, passion flower, pear, potato, Japanese quince, strawberry, English walnut, and Japanese yew.

The grape mealybug is present generally in California, where it is most important on grapes and on pears in the Santa Clara Valley, on citrus and English walnut in the coastal section, and in Florida where it injures avocado, sweet potato, and tomato. It has also been recorded from scattered localities in Oregon, Michigan, Missouri, and New York. It may be present in quantity on stored gladiolus corms, is carried over in calla lily corms to infest foliage later, and is credited with spreading a fungus stem disease of Texas bluebell.

On grape the mealybug winters as eggs under loose bark, the spring generation developing on new growth—buds, leaves, young fruits. The second generation congregates on grape clusters where excessive honeydew encourages the black sooty mold, making grapes entirely unappetizing. Ants help the mealybugs get about.

Natural enemies hold the grape mealybug in check better than sprays. Spray grapes and pears before buds open with dormant-oil emulsion. Fumigate infested bulbs with calcium-cyanide dust for 2 hours in a tight chamber.

Ground Mealybug (*Rhizoecus terrestris*)—A European species reported from California. It is small, slender, pale, covered with thin white wax, and works on roots of grasses, acacia, boxwood, chrysanthemum, currant, Shasta daisy, gooseberry, grape, larkspur, marguerite, orange, peach, pepper, petunia, plum, California privet, thyme.

Japanese Mealybug (*Pseudococcus krauhniae*)—Closely related to citrus mealybug, but differing in an elongated or serpentine egg sac. It infests orange, wisteria, and Japanese persimmon in the Ojai Valley, California. It was also reported on Western yew in New Jersey, but that was probably the Taxus mealybug, which see.

Long-tailed Mealybug (*Pseudococcus adonidum*)—Widely distributed over the world in greenhouses, and outdoors in warm climates. This species differs from other common mealybugs by having long, pencil-like filaments at the tail. These are as long as or longer than the body. Living young are produced instead of eggs.

The list of host plants is very long, including avocado and vinifera grape in addition to orange, grapefruit, lemon among subtropical fruits; and also banana, begonia, cactus, calla, cineraria, coleus, croton, dracaena, eucalyptus, ferns, fig, fuchsia, gardenia, guava, honeysuckle, mango, moonflower, oleander, Guadalupe palm, pandanus, plum, poinsettia, primrose, rubber plant, sago palm, strelitzia, umbrella plant, carob, zamia.

Mexican Mealybug (*Phenacoccus gossypii*)—Introduced from Mexico on cotton and now a general greenhouse pest as well as an outdoor problem in warm climates. It is known to be present in Florida, Mississippi, Louisiana, Texas, Arizona, Colorado, California, New York, and Illinois. This is a short-tailed mealybug, blue-gray, covered with thin powder, with posterior filaments about one fourth the length of the body. When irritated it ejects a watery fluid. The egg sac is compact, about 1/4 inch across.

Favored host plants are chrysanthemum, hollyhock, geranium, English ivy, lantana, and stock. The species feeds on citrus but is not yet very injurious.

Control. The Mexican mealybug is more readily controlled than citrus mealybugs by cyanide fumigation in greenhouses. Fumigation at high concentrations for short periods is recommended for such plants as can take it. Three to 6 fumigations at weekly intervals may be needed. Young mealybug nymphs can be killed with thiocyanate sprays such as Lethane, or with nicotine sulfate at a 1 to 400 dilution (2 teaspoons per gallon) with soap.

Palm Mealybug (*Pseudococcus nipae*), also known as **Coconut Mealybug**—This is a common greenhouse species but sometimes found in lath-houses and very rarely outdoors in southern California. It has a yellow or brown body covered with thick plates or lumps of creamy, cottony wax and is often a pest of palms.

Pineapple Mealybug (*Pseudococcus brevipes*)—Chiefly a tropical species occurring on pineapple, banana, and sugar cane but known in Louisiana and Florida. This is a toxicogenic insect which causes, by its feeding on the plant, a condition known as pineapple wilt.

Root Mealybugs (*Ripersia falcifera*)—Living on terminal or outer roots of potted plants, especially cacti. They secrete masses of loose fibrous wax. Plants die in severe infestations.

Control. Take up infested plants, shake off soil, wash roots thoroughly, and repot.

Taxus Mealybug (*Pseudococcus cuspidatae*)—First reported from a New Jersey nursery in 1915, now common in New Jersey, New York, and Connecticut and probably distributed on yew over much of the Northeast. This insect may be extremely abundant in ornamental plantings in home gardens, completely covering trunk and branches and massing together where twigs grow out of branches. The mealybugs are always on the interior of the bush and go quite unnoticed until general poor health causes a close examination. (Figure 70.)

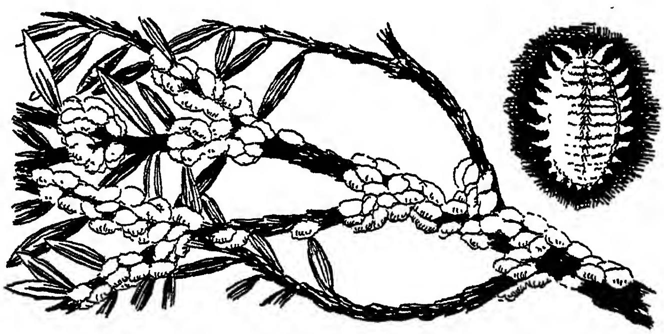


Figure 70 *Taxus mealybug on yew*

The female is about ⅜ inch long and half as wide, covered with white wax so distributed that the reddish body fluid shows through in 4 longitudinal lines. There are 15 filaments at each side of the body with tail filaments about one third the body length. This species gives birth to living young. Young nymphs winter in bark crevices and are mature by June. Apparently there are two or three broods, but adults disappear in early fall.

All species of taxus are infested. Those with dense foliage, like *Taxus cuspidata nana* and *T. wardi*, being preferred. The taxus mealybug has also been collected on apple, basswood, cedar, maple, and rhododendron, but probably does not breed on these plants.

Control. The easiest and most effective control seems to be spraying with nicotine sulfate at a 1 to 400 dilution (2 teaspoons per gallon) and soap. More than 99 per cent control is reported in experimental tests, and I can vouch for this from practical work in gardens, although I usually use a 1 to 600 dilution. My most outstanding "patient" was a taxus hedge, more than 100 feet long which, this past June, when the doctor was called in, had every trunk and every limb and twig thickly encrusted with mealybugs. The nicotine spray was applied very thoroughly, directed into the interior of the bushes, and working from both sides of the hedge. On returning in a couple of weeks to make a second application it was found unnecessary, all mealybugs, so far as could be determined in the field, having been killed with the first application.

There are a number of hymenopterous parasites of this species.

Yucca Mealybug (*Puto yuccae*)—Found in California, Arizona, and New Mexico. This species has a pale body entirely covered with thick plates of white cottony wax. Besides yucca, food plants include artemisia, aster, banana, black sage, ceanothus, eriophyllum, evening primrose, ice-plant, lantana, lemon, lime, monkeyflower. Roots, crowns, or tops may be infested.

MEALY FLATA—See **Lantern Flies.**

MICE—See under **Mammals.**

MIDGES

Midges are very small 2-winged insects of the order Diptera, and so related to flies. One family, the Chironomidae, contains the punkies and no-see-ums which make the gardener's life miserable when he takes to the woods for a vacation, and the other family, the gall gnats, make the gardener miserable when he stays home and worries about rosebuds being ruined or galls on the chrysanthemums. But some gall midges are useful, feeding on aphids, scale insects, and mites.

Artemisia Gall Midges (*Diarthronomyia artemisiae* and other spp.)—In Utah and Colorado globose bud, rosette, or bladder galls are formed on artemisia. In California there may be brownish or reddish subconical galls on underside of leaves, or white confluent woody galls on stems, or very small, oval, thin-walled hairy galls on under leaf surfaces.

Cactus Fruit Gall Midge (*Asphondylia opuntiae*)—A small gray midge with white larvae, often present in great numbers on green and ripening fruit of opuntia cactus, leaving brown pupal skins protruding from exit holes. It is common in southern California, Colorado, New Mexico, Texas.

Catalpa Midge (*Itonida catalpae*)—Recorded from the District of Columbia, Ohio, and Indiana, and probably more widely present. The insect doubtless overwinters as pupae. Minute yellow flies, 1/16 inch long, appear in late May and June to lay eggs on unfolding catalpa leaves. Whitish to orange maggots, 1/8 inch long, occur in great numbers close to midrib and large veins on underside of leaves. There are several generations a year.

The injury from the maggots looks like a fungus disease, with circular dead spots on the leaves and later wilting, browning, crumpling, defoliation. Late in the season maggots enter pods and destroy seeds. Persistent killing of terminal buds stunts and dwarfs trees.

Control. No very satisfactory solution is known. Spraying with nicotine and soap or nicotine-molasses in late May or early June might help.

Cattleya Midge (*Parallelodiplosis cattleyae*)—Yellowish maggots, 1/8 inch long, feed in tips of roots of many kinds of orchids, causing nut-like galls.

Control. Cut off and destroy galls. Repot plants and spray with nicotine when midges come out.

Chrysanthemum Gall Midge (*Diarthronomyia hypogaea*)—Imported from Europe, first noted here in 1915 and now generally distributed in greenhouses and in many outdoor gardens; found only on chrysanthemums, all varieties. The adult is a frail, long-legged orange gnat, 1/14 inch long, which lays about 100 minute orange eggs on new shoots. (Plate XXIX, page 278.) Hatching in 3 to 16 days, white to yellow or orange maggots bore their way into tissues. The irritation of their feeding causes many small cone-shaped galls on upper sides of leaves and on stems, where a number together often form knots. Developing buds are distorted and ruined. When flies emerge from the galls, usually between midnight and 4 A.M., they leave protruding empty pupal cases.

The life cycle is about 35 days, with five or six generations a year under greenhouse conditions. According to the books this is not normally a pest of outdoor chrysanthemums, attacking only those grown in very sheltered locations. But I have many times found outdoor chrysanthemums, in various locations, crippled and distorted with gall midges, although sometimes the infestation is restricted to one clump.

Control. For greenhouses, fumigation at night with tobacco papers or free nicotine (Nico Fume) is satisfactory, repeating on several successive

nights if necessary. Or a weak cyanide fumigation can be given. Spraying every second night with nicotine sulfate, 1½ teaspoons per gallon, can replace fumigation, or use the thiocyanate spray Loro, said to kill eggs and larvae in the galls. Two treatments are given at a 1 to 400 dilution followed by 4 at a 1 to 600. This may cause a little burning but the plants outgrow it.

For outdoor chrysanthemums exclusion is the first principle of control. Shun as the plague any purchase or gift of greenhouse-forced plants showing the least suspicion of conical galls. Remove and burn all infested shoots, or, better, take up and burn a whole infested plant before the adults emerge. If you keep plants showing signs of the gall midge, spray with nicotine sulfate every other evening.

False Leaf Mining Midge (*Cricotopus ornatus*)—Sometimes present on waterlily. Larvae of a small fly mine in serpentine tunnels, followed by bacteria; new leaves turn brown and rot.

Spray with rotenone or pyrethrum if there are no fish in the pool.

Grape Blossom Midge (*Contarinia johnsoni*)—A gall-gnat sometimes attacking blossoms and buds and preventing fruit development. Eggs are laid in buds, reddish maggots develop, feed, drop to the ground to pupate in a little more than 2 weeks, remaining there until the next spring.

Control measures are unknown, perhaps unnecessary.

Monterey Pine Midge (*Thecodiplosis piniradiatae*)—A common, serious pest of Monterey pines in California, present also on other pines and Monterey cypress. Very small dark flies lay orange eggs in masses on terminal buds from January to March; orange maggots feed at base of needles until November or December, then pupate in soil. Needles are shortened, yellow, often swollen at base. In serious infestations there is much defoliation; trees are greatly weakened; look as if swept by fire.

Cultivation around trees in early winter to destroy pupae is a practical means of control.

Rhododendron Midge (*Giardomyia rhododendri*)—Young leaves are rolled and margins browned by minute whitish maggots. New growth does not develop properly.

Control. Spray tips just after new growth starts with a nicotine-and-molasses spray as formerly recommended for boxwood leaf miner, or experiment cautiously with DDT.

Rose Midge (*Dasyneura rhodophaga*)—Confined to roses. Known as a greenhouse pest since 1886, the rose midge was first reported on outdoor roses in Canada in 1915 and in the United States in 1916. After that it was little heard of until 1937, since when it has been much discussed in rose circles. It arrives in a garden with unbelievable suddenness and works with devastating thoroughness. It is a far more dangerous rose pest than

the Japanese beetle, but to date it is found only in scattered gardens (though in many states) and is not yet inevitable in every garden as is the beetle in the Middle Atlantic states.

My own initiation into the ways of the rose midge came this past September when a garden of about 500 plants, which had produced gorgeously in June, had had a good summer bloom for a dull, rainy season and seemed well on its way to giving a bumper crop, suddenly stopped producing entirely. The bushes were full-foliaged, thrifty, wonderful at a distance. Only close examination revealed why a flower garden had changed almost overnight into a green garden: every potential bud in a leaf axil was black and crisp, every tiny new shoot dead, and when a bud was far enough along to be on a small pedicel it was twisted, deformed, and blackened. (Figure 71.)

Figure 71

Rose shoots injured by rose midge

The adult midge, a minute, 1/20-inch-long, reddish or yellow-brown fly, lays small yellowish eggs on succulent growth, under sepals of flower buds, on axils of tender leaves, or between unfolded leaves of leaf buds. In warm weather they hatch in 2 days, and young whitish maggots feed at base of flower buds, often 20 to 30 to a bud, or on upper side of leaves and leaf petioles, causing them to become distorted, turn brown, and die. They reach maturity (now an orange color and 1/12 inch long) in about a week; fall to the ground to pupate in small white cocoons, and the new adults appear in 5 to 7 days. The life cycle takes 12 to 16 days in greenhouses, but longer out-of-doors, according to the temperature. (Plate XXIX, page 278.)

Observations indicate that the rose midge in gardens is more apt to be a late-season pest, with June bloom all right but repeated generations of midges working from midsummer to hard frost.

Control. The best recommendation in previous years has been to cut off infested shoots immediately and keep a 1/4- to 1/2-inch mulch of tobacco dust over the soil. But by the time infested shoots are noticed most of the

maggots have already fallen down on the soil, and for a large garden that is a lot of tobacco dust to acquire and spread.

Dr. W. E. Blauvelt of Cornell University has been experimenting with DDT on greenhouse and outdoor roses and thinks it provides a much better solution to the problem. He was good enough to supply me with a small amount of the water-soluble powder (Gesarol DT 40) which I used at 2 pounds per 100 gallons in 3 applications at weekly intervals. The first had to be applied on an extremely hot day and the second on a very cold day, but in neither case was there any noticeable plant injury, and after the third application there was practically no sign of fresh infestation and the buds were coming along to give a belated but good fall bloom. There was some slight spray residue on the foliage after the third application, but doubtless the intervals could have been lengthened to 10 days and the dosage somewhat decreased. The proper DDT formulation with specific instructions will probably be available by the time this text is in print.

Violet Gall Midge (*Phytophaga violicola*)—A small fly lays white eggs in curled margins of unfolded new violet leaves. The maggots cause curling, distortion, and twisting of leaves followed by a wet rot. Infested plants are dwarfed; blossoming is limited.

Cyanide fumigation is the best treatment in greenhouses. Nicotine as a spray or for fumigation should be avoided, since it injures violets. Gather and burn fallen leaves frequently.

MILLIPEDES

Millipedes do not have a thousand legs, as the name implies, but they do have a great many legs, from 100 to 400, with each apparent body segment bearing 2 pairs. This puts them in the animal class Diplopoda. Millipedes are long, hard-shelled, grayish to brown cylindrical worms, often found coiled up like a watch spring. Most gardeners confuse them with wireworms, which are also hard-shelled but are flat rather than cylindrical, have only the 6 legs of a true insect, and do not coil up like a spring. (Compare plates XXX and XXIII, pages 279 and 230.)

Since millipedes feed for the most part on manure and decaying vegetable matter, they are useful as scavengers. They are not too much of a nuisance in home gardens but they do sometimes eat small roots, or bean, corn, or pea seed, slide into cabbage heads to horrify the cook, tunnel into potato tubers, or into carrots, beets, parsnips, or turnips. Fruits that touch damp ground, especially muskmelons, tomatoes, or strawberries, are often entered by these wiry worms. They are also found frequently in

decaying bulbs, but usually the bulbs are rotting from some other cause and the millipedes are there as scavengers. Chief injury is in greenhouses in soil rich in organic matter. There roots and stems of seedlings and older plants may be attacked.

The life history of millipedes is not too well known. In some cases, eggs, translucent and covered with a sticky material, are laid in soil in clusters of 20 to 100, with each female depositing about 300. In 3 weeks they hatch into small worms differing from adults in size and in fewer segments and legs.

Control. General sanitary practices will ordinarily be sufficient control in the home garden, together with the use of salt hay or other mulching material to keep ripening fruits from touching the ground. In greenhouses raw potatoes cut into pieces and smeared with paris green or sodium fluoride are good as bait. Or a poison bran bait can be used: 2 quarts dry bran, 1 ounce paris green, 1 cup molasses thoroughly mixed and moistened with 1 quart water. This bait is put in little piles around the greenhouse. If used outdoors the piles should be covered with jar tops or bits of board to keep from poisoning birds.

Small amounts of greenhouse soil can be drenched with bichloride of mercury, 1 to 1,000 dilution, but not for a rose house, since roses are allergic to mercury vapor. Boiling water is a remedy for millipedes if they congregate under boards.

MITES

Mites are not true insects. They belong to the animal class Arachnida, which includes spiders, scorpions, harvestmen (daddy longlegs), and ticks, all grouped together by the fact that they have 4 pairs of legs instead of the 3 pairs found in members of the insect class Hexapoda. Arachnids also differ from insects in lacking antennae, true jaws, and compound eyes, and in having only 2 body regions, head and thorax being joined together. Mites, members of the order Acarina, further differ in having the body seemingly all one piece, without segments, and the young forms having only 3 pairs of legs, the fourth added at maturity. Ticks are the large members of this order, mites the very small, almost microscopic forms.

Many mites injure man or animals. The plant pests can be divided roughly into the red spider group, family Tetranychidae, including common red spiders, Pacific mite, six-spotted mite, European red mite; the soft-bodied mites, family Tarsonemidae, with the cyclamen mite the most important member; the root mites, family Tyroglyphidae, which

includes the bulb mite; and the blister or gall mites, family Eriophyidae, which takes in pear leaf blister mite, ash flower gall (discussed under Galls), and many others. There are also running mites, common active mites larger than red spiders, very red, often on or in the ground; but they are friends, preying on other mites and various small insects.

Almond Mite—See **Clover Mite.**

Avocado Red Mite (*Paratetranychus yothersi*)—Often known as **Avocado Brown Mite** because of its color and the injury produced. Since 1909 this mite has been increasingly important on avocado in Florida, and since 1926 has been a real pest of this host in coastal areas in California. Mango is the next most important food plant, but avocado red mite has been reported on camphor trees, Australian silk oak, eucalyptus, elm, willow, white oak, and pecan.

Smoky-amber eggs are laid singly on upper surface of the leaf at the base and along the midrib. Young larvae, hatching in 7 to 10 days, are light yellow with carmine eyes, but the adults are brownish. Leaves turn reddish-brown and trees are more or less defoliated—in winter in Florida, more often in summer in California.

Control. Dusting with sulfur is most satisfactory.

Blackberry Mite (*Eriophyes essigi*)—Found in the West, too small to see without a microscope. This mite feeds near the base of drupelets, preventing fruit from ripening in whole or in part, causing "redberry disease." Affected fruit stays bright-colored, hard, clings to bushes. The mites winter in the buds.

Control. Apply a dormant lime-sulfur solution, 1 part to 15 of water, in March just as buds are opening, and a second spray, at a 1 to 40 dilution, in early May when fruiting arms are about a foot long.

Boxwood Mite (*Neotetranychus buxi*)—The avocado red mite is also recorded as a boxwood mite. Injury on boxwood shows as a light mottling of leaves early in the season, followed by a general grayish, dingy, unhealthy appearance. The early signs look like minute hen scratches. The mites are yellow, green, or reddish, 1/64 inch long when full-grown. Eggs winter on leaves, hatch in April; mites breed rapidly with five or six generations in a summer.

Control. An easy, efficient measure is dusting bushes with fine dusting sulfur, blowing it well into the interior. Summer oil sprays are also effective, but should not be used on bushes which have been receiving sulfur within a month. DDT used to control boxwood leaf miner encourages mites, so the sulfur treatment will almost certainly be necessary.

Broad Mite (*Hemitarsonemus latus*)—Often associated with cyclamen mite and causing similar injury in greenhouses and sometimes in gardens. The broad mite is pale, almost transparent, slightly smaller and wider

than the cyclamen mite, moves about more rapidly, and usually feeds exposed on undersurface of leaves. It can complete a life cycle in 7 or 8 days. Like the cyclamen mite, which see, it attacks a great many ornamentals—cyclamen, delphinium, snapdragon, African violet, begonia, china aster, marguerite, chrysanthemum, fuchsia, lantana, gerbera, geranium, marigold, verbena, zinnia, pepper, and a few other vegetables. The injury is a blistered and silvery appearance to the leaf, which may become rather brittle, and sometimes a puckering downward.

Control. Sulfur dust is effective for this mite, 2 or 3 applications often eliminating it. Either nicotine or cyanide fumigation is satisfactory in greenhouses.

Bulb Mite (*Rhizoglyphus hyacinthi*)—A garden pest in the West, more common in greenhouses in the East. Serious injury is caused to bulbs or corms of amaryllis, crocus, freesia, gladiolus, hyacinth, lily, narcissus, onion, tulip, and to underground stems of asparagus, peony, and some other plants.

The mite is whitish, often with 2 brown spots on the body, 1/50 to 1/25 inch long, slow-moving, found in colonies. It is abundant on rotting bulbs and tubers and decaying plant material, but it can burrow into healthy bulbs, carrying with it bacteria and fungi causing rot. Opinions differ as to the penetration of absolutely sound bulbs. The bulb mite spreads infection from diseased to healthy bulbs in the field, greenhouse, and in storage. It breeds rapidly under favorable temperature and moisture conditions, producing up to ten generations a year.

The life history is rather interesting. A 6-legged larva emerges from the egg and lives from 3 to 8 days, the last of the period spent in a quiescent state during which it swells so that the line between thorax and abdomen is lost. On molting it acquires 2 more legs and is known as a protonymph; after 2 to 4 days and a second quiescent period it molts again and becomes a tritonymph, after which it molts into the adult mite. If conditions are unfavorable after the second molt it goes into a resting stage called a hypopus, really the deutonymph stage. As a hypopus the mite attaches itself to any moving object and is frequently carried by flies and other insects from plant to plant or from bed to bed.

Control. Store only sound, healthy bulbs. One or 2 infested bulbs in storage may ruin the rest. Store at low temperatures, around 35° F. At planting time discard any seriously infested bulbs, and dip bulbs suspected of harboring mites in nicotine-sulfate solution held at 122° F. for 10 minutes, or immerse in hot water held at 110° F. for 2½ hours.

A California recommendation is to place bulbs, after digging and curing, in a 2 to 4 per cent commercial lime-sulfur solution heated to 125° F. and held for 1 minute. Bulbs are then dried and stored. Small

lots of bulbs are placed in paper bags with 2 per cent nicotine dust, the bags tied, and the bulbs left for several days, or until planting time.

Predaceous mites attack the bulb mite.

Citrus Red Mite (*Paratetranychus citri*), commonly called **Red Spider** by many citrus growers, and **Purple Mite** in Florida—It is less of a pest in moist Gulf states than in more arid California. It prefers lemons in California, satsuma oranges in Alabama, but is also found on oranges and grapefruit, infesting fruit, leaves, and tender branches. Sap removal produces grayish splotches on leaves and gives a grayish cast to the whole tree. A heavy mite infestation means a light fruit crop.

Red eggs are laid on fruit, twigs, leaves. Larvae are at first orange, later dark red; females are almost black; males are lighter red but with a dark band around the body; there are white bristles in red tubercles.

Control. A yearly application of an oil spray keeps this mite under control better than several applications of sulfur. In Alabama this spray is applied in July. D-N Dust, preferably in 2 applications, also gives adequate control.

Citrus Rust Mite (*Phyllocoptes oleivorus*)—Present in Florida, Alabama, Louisiana, Texas, and California. This species is more serious in the Gulf states than in California, where injury is restricted to lemons in one or two localities. Lemon is the preferred host, then lime, citron, grapefruit, orange, tangerine, calamondin, satsuma, mandarin, kumquat in that order. In Florida more than 50 per cent of oranges and grapefruit are more or less injured by rust mites. They attack leaves, stems, twigs, but most injury is in the russeting of fruit. A slight attack gives "golden" fruit; a severe attack starts as faint black areas on green fruits, increasing until the whole fruit looks rusty, dry, and rough. The outer cells are killed by mite feeding, size is reduced, rind thickened, quality impaired.

The rust mite is long, wedge-shaped, and orange when adult, but with pale larvae that move very slowly. Eggs are laid in depressions in fruit, oranges preferred. Cycles are completed in 10 days or less, and enormous populations are built up in a short period. In Alabama they are first seen on foliage in late April, disappear in December. In Florida they are present throughout the year, but least numerous in January and February.

Control. Sulfur is a specific for the rust mite. It may be applied as lime-sulfur, but sulfur dust is particularly effective.

Clover Mite (*Bryobia praetiosa*), known also as **Almond Mite** and **Brown Mite**—Distributed throughout the United States. Hosts include deciduous orchard trees—apple, apricot, almond, cherry, peach, pear, plum, prune, raspberry, some forest trees—especially aspen and cottonwood—and some herbaceous plants. In southern states the mite winters on various clovers and malva, but in the North it winters as small red

eggs, looking like brick dust, on surface of bark and around buds of orchard trees. They hatch in spring; the mites feed by piercing epidermis of leaves and extracting juice; foliage turns yellow and may drop. The young mite is red, adult rusty brown—the largest of the plant mites and distinguished by a pair of front legs longer than the body.

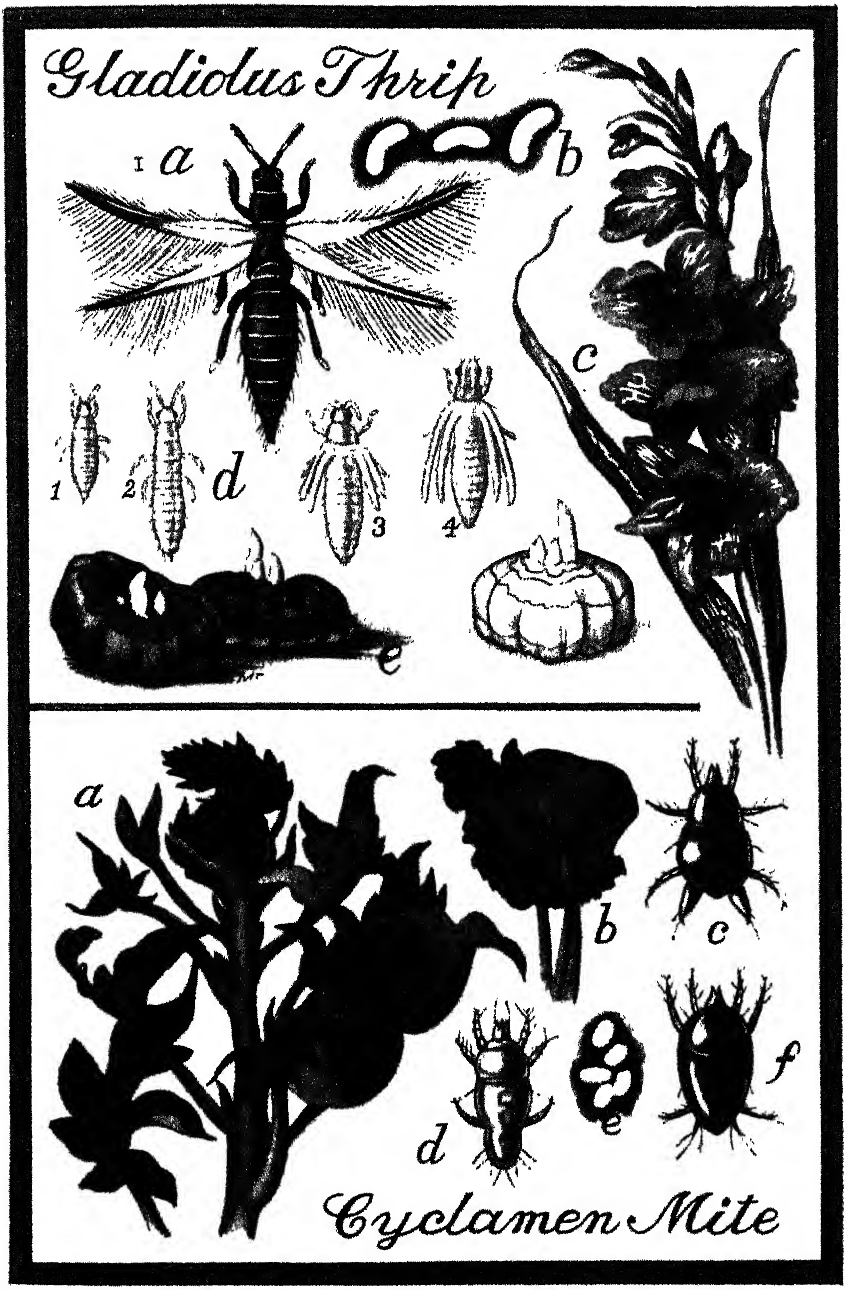
Control. A dormant oil emulsion is used against overwintering eggs just before buds break in spring. Lime-sulfur 1 to 10 can be substituted. In summer, sulfur dust or lime-sulfur at a 1 to 50 dilution with wettable sulfur added, is satisfactory.

Common Red Spider (*Tetranychus telarius* and other species). The exact nomenclature of the various species known as red spider is somewhat confused, but few people who have grown phlox in the garden or ivy in the house are confused about what red spiders do to plants. They are of world-wide distribution, common on greenhouse and house plants, on many ornamentals, and some fruits and vegetables in the garden. A partial list of plants apt to be heavily infested at times includes almond, amaryllis, asparagus fern, arborvitae, begonia, bean, cedar or juniper, celery, chrysanthemum, cacti, carnation, clematis, citrus (though not so serious as other citrus mites), corn, cosmos, cowpea, crotalaria, cucumber, dahlia, delphinium, eggplant, fuchsia, hollyhock, hawthorn, heliotrope, hydrangea, ivy, onion, okra, melon, mignonette, nasturtium, pea, phlox, primrose, rose, snapdragon, sweet pea, strawberry, tomato, violet.

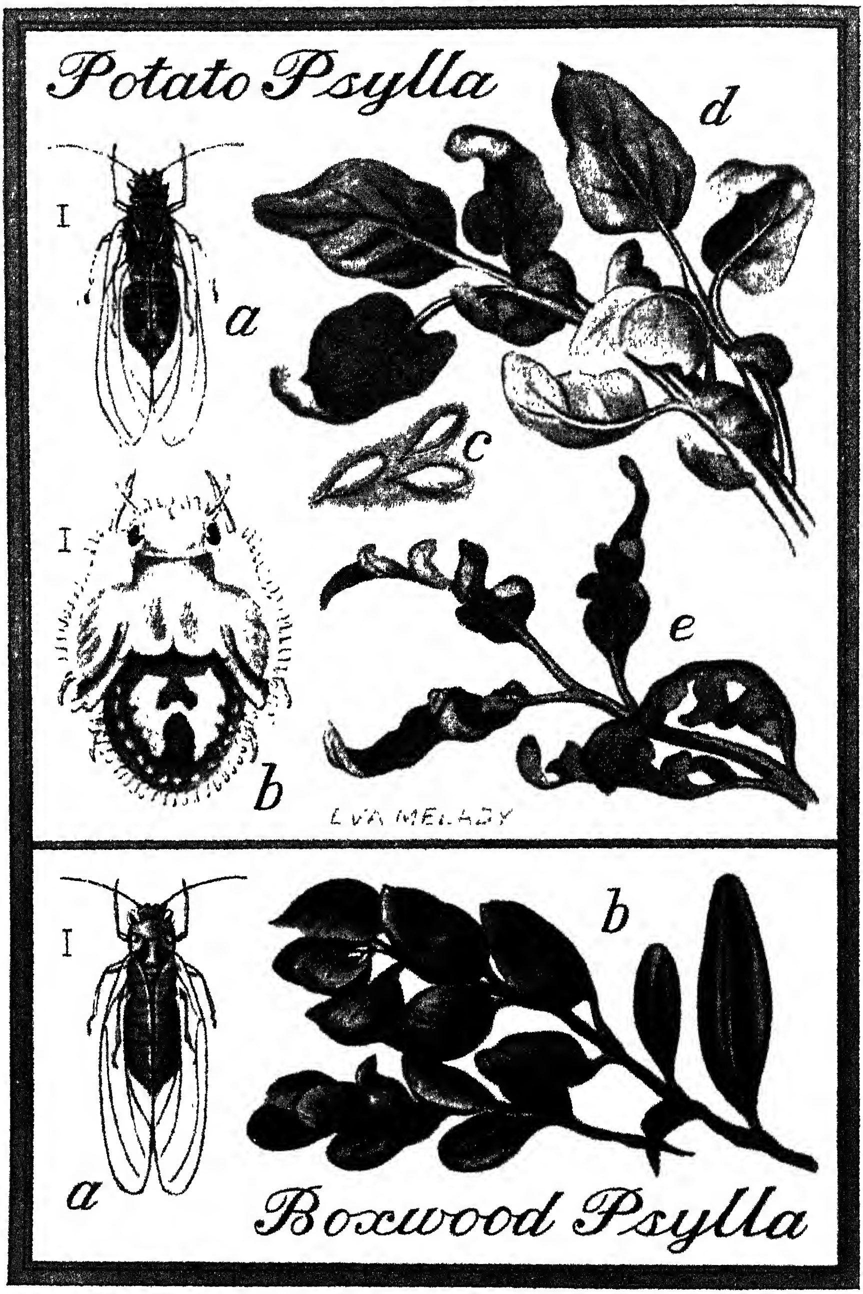
Red spiders are very small; the female adult is 1/60 inch long, the male even smaller. They vary in color from pale yellow to orange, red, or greenish, and are profuse web spinners. (Plate XXVIII, page 271.) To the naked eye they are minute specks running up and down mealy cobwebs spun on the underside of leaves or sometimes from one leaf to another, or covering a new shoot, flower buds and all. Young mites are usually pinkish, with 6 legs; the 8-legged adults are more often yellow or green. Outdoors they hibernate as adults in soil, on tree bark, on leaves of weeds and ornamentals which retain foliage; but in the greenhouse they continue breeding, with a new generation every 20 to 30 days. Eggs are laid on leaves, fruit, or wherever mites are feeding.

Red spiders feed by piercing the foliage, mostly from underneath, with 2 slender projections attached to the mouth, and then drawing out the sap. Infested leaves are mottled gray or yellow; often the whole plant has a brown, sickly look; with severe infestations there is considerable leaf drop.

Injury from red spiders is supposed to be most serious in hot, dry outdoor climates or in the hot, dry air of the average living room, but these pests are almost equally injurious under conditions of high humidity when the air is stagnant. Outdoors, hollyhocks planted near overhanging house



XXXI **GLADIOLUS THRIPS:** **(a)** adult, showing fringed wings; **(b)** eggs (much enlarged); **(c)** typical injury to flowering spike and foliage; **(d1)** first-stage larva (actual color white with red eyes); **(d2)** second-stage larva; **(d3)** third-stage or prepupa (color orange); **(d4)** true pupa with wing pads; **(e)** two injured corms, at left, and healthy corm. **CYCLAMEN MITE:** **(a)** delphinium spike, showing typical distortion; **(b)** injured cyclamen flowers; **(c)** adult male, highly magnified; **(d)** young 6-legged larva; **(e)** eggs; **(f)** adult female.



XXXII **POTATO PSYLLID (PSYLLA): (a)** winged adult; **(b)** nymph, showing white fringe; **(c)** eggs (highly magnified); **(d)** psyllid yellows on potato; **(e)** on tomato. **BOXWOOD PSYLLID (PSYLLA): (a)** winged adult; **(b)** terminal leaves of boxwood curled or cupped by feeding of nymphs inside.

eaves, roses in a walled garden, phlox in dense clumps, primroses and violets tucked away under shrubbery, hemlocks in a close hedge—almost any plant away from free and continuous air circulation is apt to get a bad dose of spider mites. This past summer, in the wettest July on record in this locality, I found more red spiders on roses than ever before, probably because there was never a good stiff breeze to change the heavy, muggy air.

Control. Avoid placing susceptible outdoor plants close to houses or walls where there is little circulation of air; keep house plants cool and humid, with a weekly bath for smooth-leaved specimens like ivies; syringe garden plants like phlox with a strong stream of water from the hose, early enough in the day so the foliage will dry before night.

Fine sulfur dust will usually hold red spiders in check. Its effectiveness increases with temperature, but if it is applied at 90° F. or over there is much danger of burning plants. Wettable sulfur sprays, dilute lime-sulfur, nicotine sulfate and soap, rotenone, potassium sulfide (1 ounce to 2 gallons water), or some of the thiocyanate sprays—Lethane or Loro—are all useful.

Evergreens may have a dormant application of miscible oil just before new growth starts in spring or may be sprayed with glue during the growing season (1 pound dissolved in warm water and diluted to 8 gallons).

There is a new and really remarkable control for red spiders on carnation, snapdragon, and other greenhouse plants. Sodium selenate applied to the soil in minute amounts is taken up by the plant which becomes toxic to the mites. One treatment keeps plants pest-free for 3 to 6 months. Sodium selenate cannot be used on vegetables for it would make them too poisonous to man. The margin of safety between plant injury and mite control is too small to make the material safe for amateur growers in outdoor gardens, since it must be put on with water measured exactly for a certain number of square feet. It does mean that flowers obtained from florists will be less apt to bring spider mites into the home to infest house plants. A new fumigant, azobenzene, seems destined for wide use for red spider control in commercial rose greenhouses.

Currant Bud Mite (*Eriophyes ribis*)—Injurious to black, native, and flowering currants. The buds swell and die before opening, after which the mites emerge to infest buds on normally developing canes.

Control. Cut and burn infested shoots; dust with sulfur in early spring.

Cyclamen Mite (*Tarsonemus pallidus*), also known as **Pallid Mite** and **Strawberry Crown Mite**—This species was first noted in New York in 1898 and is now generally present throughout the country as both a greenhouse and a garden pest. Particularly injurious to cyclamen and

snapdragon, the greenhouse list includes African violet, ageratum, azalea, begonia, Boston ivy, chrysanthemum, crassula, delphinium, fuchsia, geranium, gerbera, marguerite, lantana, marigold, verbena, zinnia. Outdoors, the cyclamen mite is probably the worst enemy of delphinium, deforms aconite and snapdragon, is a strawberry pest, particularly in the Northwest, works on peppers, sometimes tomatoes.

Since this mite is too small to see with the naked eye it is identified chiefly by very characteristic deformation of foliage and flowers, together with general stunting.

Cyclamens infested when young do not flower; if infested later the blooms are distorted, streaked, or blotched, and fall early; the foliage curls into cups, is wrinkled with depressions, may be purplish in color. (Plate XXXI, page 294.)

Delphinium leaves are thickened, puckered, lose their normal indentations; flower stalks are gnarled, twisted, darkened, seldom open; buds turn black; the whole plant may be less than a fourth normal height. Mite work on delphinium is often known as "blacks" and thought to be a real disease.

Mites feeding in young, unfolding leaves of strawberry crowns cause stunting, distortion, chlorosis, browning, shriveling of flowers, no fruit.

The cyclamen mite is glassy white or transparent pale green, less than 1/100 inch long, slow-moving. It hides in crevices of buds and leaves, the female laying 5 or 6 eggs a day for 2 or 3 weeks. These hatch in a week or less into 6-legged larvae (young stages of mites are called either larvae or nymphs) which are active for 7 days, then quiescent for 3 before changing to the 8-legged adult.

Control. Exclusion is the first principle of control. Purchase only perfect, healthy specimens, whether they are delphiniums for the garden or saintpaulias for the house. Sound control measures include spacing plants in house or greenhouse so that they do not touch each other; avoiding handling clean plants after touching possibly infested plants. It is not too much to insist on clean stock from your florist, since he now has two methods of getting rid of mites in lightly infested plants after destroying stunted, deformed specimens. Immersing plants in hot water held at exactly 110° F. for 15 minutes will kill mites and is not injurious to young plants, though it may injure cyclamen in bud and blooming stages. The new aerosol bomb method of applying insecticides in greenhouses has been particularly successful against cyclamen mite on snapdragon and will doubtless be available to florists in the near future.

Cyclamen mites, unlike broad mites, do not succumb readily to sulfur sprays, dusts, or vaporizer, or cyanide fumigation. Some suggest naphthalene flakes in soil of potted plants, but they should be used with great caution for fear of injury.

In planting strawberries secure clean stock, preferably certified. The state of Washington maintains a certification service to supply clean strawberry stock to growers, who are urged to rotate crops and to discard and burn all old plants at the end of the second year. New stock suspected of being infested should be soaked in hot water at 110° F. for 30 minutes.

Delphiniums in seedbed and garden should be sprayed with a strong rotenone solution, using a 1 to 400 or even a 1 to 200 dilution, starting in early spring. A combination sulfur-rotenone dust will have some effect and will take care of broad mites often present with cyclamen mite, but is not so efficient as a rotenone spray. Delphiniums seriously infested should be removed and burned before mites are carried to near-by plants in cultivating and handling.

Date Mite (*Paratetranychus heteronychus*)—An important pest of date palm in California. This pale yellow mite may also infest Washingtonia and Canariensis palms as well as grasses growing near date gardens, and may sometimes be present on maple, cypress, and various ornamental trees. Leaves and fruits are webbed together, and the mite feeding scurfs the fruit, which shrivels, cracks, turns yellow.

Control by dusting with sulfur.

European Red Mite (*Paratetranychus pilosus*)—An imported species first noted in this country in 1911, now well distributed throughout the Northeast, Pacific Northwest, Arizona, and other states. This mite is particularly injurious to apple, pear, plum, prune, but may infest all types of citrus, almond, walnut, and many ornamental trees and shrubs.

Hibernation is in the form of bright red to orange stalked eggs on twigs and smaller branches, often in crevices of fruit spurs. They hatch in spring just before blooming; the young mites crawl to unfolding leaves to suck sap but do not make so much webbing as red spiders. The foliage is speckled and turns a sickly bronze in heavy infestations, looking as if covered with dust. Fruit buds are weakened, many leaves drop, fruit is undersized, of poor quality.

The adult mite is bright to brownish-red, unspotted, with 4 rows of curved spines down the back, 1/75 inch long.

Control. A dormant oil spray (3 per cent lubricating oil emulsion or a miscible oil) will kill overwintering eggs. Lime-sulfur will not kill eggs but if used as a fungicide in later sprays will kill young mites. When DDT is used on fruits the control of red mite becomes very important.

Filbert Bud Mite (*Eriophyes avellanae*)—Mites invade buds causing a great swelling, 2 or 3 times normal size, known as filbert big-bud. There is no further development into foliage. In May, when the mites leave swollen buds and start crawling to normal buds, some of them can be killed by spraying with nicotine.

Pacific Mite (*Tetranychus pacificus*)—This is a small pale green or yellow or reddish mite, similar to common red spider. It is an important pest of grape, turning foliage prematurely red or brown, may web bean leaves, and cause blackberry, plum, prune, or walnut leaves to turn brown, dry, and drop. It may also infest chinaberry, mock orange, and wild currant.

Control. Dust beans with sulfur as soon as mites appear; spray blackberries, grapes, and other fruits with 1½ per cent summer oil; dust walnuts with DN-Dust.

Pear Leaf Blister Mite (*Eriophyes pyri*)—Present wherever pear trees are grown and sometimes found on apple, mountain-ash, shadbush, and cotoneaster. This species was introduced into America about 1870 and has been spread about on nursery stock. Brownish blisters appear on undersides of leaves, each one about ⅛ inch across, but often massed together to cover or nearly cover the whole leaf. When the blisters are opened small, elongated, pinkish, or white mites can be seen with a hand lens. Fruit buds turn brown or produce weak flowers, russeted or misshapen fruits. The mites winter in bud scales in temperate climates but in warm states they enter and destroy bud contents. In the Northwest they winter as eggs, hatching in early spring. There are several generations.

Control. If blister mite is a serious problem apply a dormant spray, fall in California, early spring in New York—lime-sulfur at a 1 to 15 dilution, or a miscible oil. When there has been much bud injury the California fall spray should consist of 2 per cent oil emulsion plus 5 per cent lime-sulfur.

Privet Mite (*Tenuipalpus bioculatus*)—Plants are seriously injured, sometimes killed, by mites feeding on undersurface of leaves, which turn yellow. Sometimes Ligustrum leaves bear several hundred blood-red eggs in clusters with six or seven generations in South Carolina.

Spray with wettable sulfur or use sulfur dust.

Six-spotted Mite (*Tetranychus sexmaculatus*), or **Yellow Mite**—A pest of citrus in the Gulf states and parts of California. The adult is pale yellow, feeds on underside of citrus leaves in very definite areas, often near veins, which are depressed and covered with webs. The upper portion of the leaf has yellowish blisters with a smooth shiny surface.

Control with oil sprays or DN-Dust.

Southern Red Mite (*Paratetranychus ilicis*)—The red spider of the South. This minute red species is a major pest of azaleas and infests a wide variety of ornamental trees and shrubs, especially camphor, cypress, eucalyptus, loquat, live oaks, sycamore, and English walnut. The mites feed on both leaf surfaces, rasping the epidermis. The adult females are nearly black, the males and nymphs light red. Both have spiny hairs

curving backward. Red eggs are laid on both leaf surfaces. Heavily infested leaves look as if they had been dusted with red pepper; they turn brown, often drop. There are many generations, but this is a cool-weather mite, building up populations during winter months and not very important in summer.

Control. Clean up mite infestations while the population is low, using a summer oil, such as Florida Volck, at 1½ per cent concentration. Applied in October to azaleas in Alabama it will carry them through the blooming season, after which another oil spray may be needed. On some shrubs and ornamental trees southern red mites can be taken care of by forcefully and thoroughly drenching with the hose.

Sulfur dust is satisfactory for some plants.

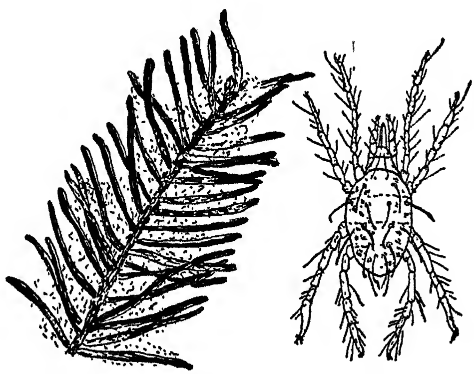


Figure 72

Spruce twig webbed by spruce mite, and mite as seen under a microscope

Spruce Mite (*Paratetranychus ununguis*)—Widely distributed through the North Temperate Zone. This species, dark green to almost black with spines on the back and salmon-pink legs, attacks nearly all conifers with special attention to blue spruce, other spruces next in order, then cedar and certain pines. Spherical eggs, wintering at base of needles, hatch in April and May, complete a generation in an average of 17 days, and keep on building up populations until winter eggs are laid in October. Injury is most serious in hot, dry seasons. The mites spin a quantity of webbing between needles, the foliage turns gray or bronze. (Figure 72.) Young trees may die the first season; older trees die progressively, from lower branches upward, over a period of years.

Control. Spray with a miscible oil, 1 to 25, or the proper dilution for evergreens according to manufacturer, before new growth starts in April. During the growing season spray with glue (see Common Red Spider) or hose the tree with great force to break the webs, holding the thumb down over part of the nozzle or screwing it down to increase pressure.

Tomato Russet Mite (*Phyllocoptes destructor*)—A new pest first noted in California in 1940, origin unknown. It has since spread over most of California. Besides tomato, it infests petunia, potato, nightshade, tomatillo, and datura. Typical injury is a bronzing or russeting of surface of stems and leaves, with feeding starting at base of the main stalk. Leaves turn brown 3 or 4 weeks later. Fruit is attacked only in severe cases, but loss of foliage results in sunburned fruit.

Control. Dusting with sulfur seems adequate.

Two-spotted Mite (*Tetranychus bimaculatus*)—One of the common red spiders, which see, distinguished by 2 large black spots on the body.

Walnut Blister Mite (*Eriophyes tristriatus erineus*)—Producing yellow or brown felt-like galls on undersides of leaves. This is not a very injurious pest and can be cleaned up in extreme cases by a dormant spray of 1 to 10 lime-sulfur in spring when buds are swelling.

MOLES—See **Mammals.**

MOTHS

Moths belong to the insect order Lepidoptera. They have scaly wings like butterflies but the body is usually larger. They are mostly night fliers; the antennae are filamentous or feathery but are rarely enlarged at the tip, and the wings, when at rest, are held roof-like, wrapped around the body or held horizontally but not vertically like those of butterflies. Larvae of moths are caterpillars. Those that are commonly known by their larval stage are discussed under Caterpillars, which see, or Cankerworms, Hornworms, Worms, et cetera.

Abutilon Moth (*Anomis erosa*), or **Okra Caterpillar**—This is a semi-looper, light green like the cabbage looper, growing to 1⅜ inches long, pupating in a folded leaf. It feeds on okra, hollyhock, hibiscus, and mallow. It can be readily controlled with lead arsenate if its parasitic wasp does not do the job well enough.

Achemon Sphinx (*Pholus achemon*)—Adult of a large green or pinkish caterpillar, with oblique white bars on the side, sometimes defoliating grapevines, feeding also on wild grapes and Virginia creeper. The young larva has a black horn which disappears with the first molt. The moth is large, wings expanding to 3 or 4 inches; the fore wings are gray with brown marks, the hind wings pink; it is a night flier. Pale green eggs are laid on upper surface of leaves; pupation is in mahogany-brown chrysalids in soil; there are two generations.

Control. Spray with arsenate of lead or dust with sulfur-lead arsenate dust when young caterpillars appear.

Apple Fruit Moth (*Argyresthia conjugella*)—Larvae burrow into apple fruit in northern California. Moth is pale yellow with purple-brown fore wings marked with dark bands.

Artichoke Plume Moth (*Platyptilia carduidactyla*)—The adult has divided wings, is buff brown, has a 1-inch wingspread. Caterpillars feed on new foliage and mine inside stems, leaf stalks, buds, with noticeable damage to the head. There are three overlapping generations in California with most injury in spring.

Control. Pick and destroy all wormy artichokes, bury all old plant tops under 12 inches of soil, remove near-by thistles. Spray with pyrethrum and oil (2 teaspoons pyrethrum extract in a gallon of 2 per cent oil emulsion).

Azalea Sphinx (*Amphelophaga choerilis*)—Known on azalea, sour gum or tupelo, and viburnum. The moth is large, 2½ or more inches across, reddish-brown. The hornworm caterpillars are not very destructive.

Brown-tail Moth (*Nygmia phaeorrhoea*)—Introduced into Massachusetts on nursery stock prior to 1897 and now present in all New England states. It is common on apple, cherry, oak, pear, plum, rose, willow, occasionally on elm and maple; is rarely found on hickory, ash, chestnut, and birch, never on evergreens.

The caterpillars, 1½ inches long, are reddish-brown to nearly black, with a broken white stripe along each side, a red tubercle on segments 11 and 12, and covered with tufts of brown hairs. These hairs are barbed and poisonous, causing a severe rash when they touch the skin, and credited with causing death when large numbers of small hairs are breathed into the lungs. They winter as young larvae, webbed together several hundred in a nest, feed during the spring, and in June pupate in a cocoon among webbed leaves.

The moths are pure white except for brown scales at the tip of the abdomen (the brown tail), have a 1½-inch wingspread, are active fliers, and appear in July to lay eggs in globular yellow clusters, covered with light brown hairs, on underside of leaves. There is one generation a year.

Control. Cut off and burn winter webs; spray trees with lead arsenate in early spring when the leaves come out, or in August when young caterpillars appear. A fungus disease kills many caterpillars. Brown-tail moths are included in quarantine regulations for the Gypsy Moth, which see. For recipe for a soothing medication for the rash see Puss Caterpillar.

Buck Moth (*Hemileuca maia*)—Present in most of the United States but rather rare in the East, named because it appears in autumn when deer run. Caterpillars usually feed on oak, sometimes on willow. They

are gregarious, brownish-black, covered with yellow oval bumps (papillae) and each segment, except number 11 which has 5, bears at least 6 tufts of spines, irritating when they touch the flesh. Moths are brown or blackish except for a wide white band extending across both pairs of wings and enclosing wing spots. Eggs, laid in fall in a ring around a branch, hatch in May. Caterpillars eat enormously until July, when they pupate in the ground.

Control. Spray with lead arsenate when caterpillars are young.

California Oak Moth—See **California Oak Worm.**

Catalpa Sphinx (*Ceratomia catalpae*)—Confined to this host, most important in a zone from New York to Colorado, but known in the Gulf states, including Texas. Early fishermen in Georgia and Florida cultivated catalpa trees to get the sphinx caterpillars for fish bait, but this use is more than offset by almost complete defoliation of trees in some areas, often followed by death.

The caterpillars are about 3 inches long, with a black horn, a dark body with green markings, varying with the individual. The hawk moths are gray with irregular light and dark markings, up to 3 inches across the wings. The winter is passed as naked brown pupae in the soil under or near catalpa trees. Moths fly as soon as trees come into leaf, laying up to 1,000 eggs in white masses on underside of foliage. Young caterpillars start feeding in 2 weeks, first in groups, later separately. There may be two generations, perhaps a partial third.

Control. Spray trees with lead arsenate as soon as young larvae appear, or dust with lead or calcium arsenate. Eggs and caterpillars are heavily parasitized so that severe outbreaks appear only at intervals.

Cecropia Moth (*Samia cecropia*)—More conspicuous than destructive. This is one of the huge silkworm moths, wings spreading to 5 or 6 inches, dusky brown, with a white crossband bordered with red, and a red spot near the apex of each fore wing, a white crescent-shaped spot in the center, and coral-red, blue, and yellow tubercles on the body. The caterpillars are pale green, ornamented with blue, red, and yellow tubercles 4 inches long. They feed on oak and many other trees—linden, maple, boxelder, elm, birch, willow, and poplar. Large gray-brown silk cocoons are conspicuous on bare trees in winter.

Control by removing and destroying cocoons.

Codling Moth (*Carpocapsa pomonella*), or **Apple Worm**—A European species distributed throughout apple-growing sections of the world. It came to this country prior to 1819 and is the most serious pest on apple and pear fruit that we have. (Plate XXVI, page 239.) Crabapples, apricots, cherries, loquats, peaches, plums, haws, and similar fruits are occasionally attacked, and green nuts of English walnut commonly in-

fested in California. With the best of control measures codling moths continue to destroy 10 to 15 per cent of the apple crop, while uncared-for fruit will be 20 to 95 per cent infested.

The insect winters as a full-grown larva, an inch-long pinkish-white caterpillar with a brown head inside a silken cocoon under loose scales on apple bark or in other sheltered places. In spring the worms change to brown pupae and the moths emerge in 2 to 4 weeks. They are grayish-brown, with irregular golden-brown lines on the fore wings and paler, fringed hind wings, spreading from ½ to ¾ inch. They lay flat white eggs, singly, on upper surface of leaves, on twigs, and on fruit spurs. They work at dusk, when the weather is dry and the temperature fairly high—above 55° F.

A cold, wet spring at the time of egg-laying means less trouble with wormy apples. Hatching in 6 to 20 days, small worms crawl to young apples, entering by way of the calyx cup at the blossom end. They tunnel to the core, often eating the seeds, then burrow out through the side of the apple, leaving a mass of brown excrement behind, and crawl to the tree trunk to pupate for the next generation. There are two generations over most of the United States, and in some places a partial third. Second-brood larvae enter the fruit at any point without preference for the blossom end.

Crop reduction comes not only from wormy fruit but also from early drop of immature apples and from "stings"—small holes surrounded by dead tissue which lowers fruit value even though the worms are poisoned before doing further damage.

Control. Spraying with lead arsenate is the common control measure, and the most important application is the petal-fall or calyx spray, applied when most of the petals have fallen but before the calyx cup closes. The commercial orchardist applies a second spray 10 days later, a third 10 days after that, and several cover sprays during the summer to take care of the second brood. Lead arsenate is usually combined with a fungicide to control apple scab and other diseases, but specific recommendations vary with the locality. State experiment stations supply local spray schedules.

In the Pacific Northwest cryolite or oil and nicotine are often substituted for the later sprays, but more than 2 or 3 treatments of either lead arsenate or cryolite will leave more than the legal tolerance of poisonous residue, so the fruit has to be washed with dilute hydrochloric acid or other chemical.

DDT seems very promising in control of codling moth, but more work is needed before it will be regularly recommended to growers.

As a home gardener with one or two fruit trees you will probably

content yourself with having the local tree expert come in to put on a calyx spray and perhaps a second application 10 days later. It won't be very satisfactory but it will help some. If you have dwarf fruit trees you can get fair control of codling moth by dusting with sulfur-lead arsenate dust.

Supplementary control methods include: banding trees with cloth or paper bands treated with beta-napthol (prepared bands are on the market), cleaning up the orchard by scraping loose bark from trees, removing rubbish and all dropped apples immediately. There are several insect enemies of codling moths, but it is unlikely the biological control will ever make artificial measures unnecessary.

Cynthia Moth (*Philosamia cynthia*)—One of the few insects known to feed on ailanthus or tree-of-heaven, which may be completely defoliated. It also feeds somewhat on wild cherry, linden, sycamore, lilac, and other trees. This species, one of our largest moths, was introduced in the hope of making silk from its cocoons. It is a beautiful brown with white markings, with a wingspread of 6 to 8 inches. The caterpillars are green with black dots and blue tubercles, 3½ inches long, found mostly near cities.

Control. Spray trees in June with lead arsenate.

Cypress Moth (*Recurvaria apictripunctella*)—The larvae of this very small moth sometimes feed on foliage of bald cypress in late spring or early summer, causing badly browned foliage.

Presumably arsenate of lead will control this insect.

Cypress Tip Moth (*Argyresthia cupressella*)—Common on Monterey and other cypresses in California. The adult is small, golden, with brown markings, only ⅓ inch across; the larva is yellow-green with a brown head, ¼ inch long. It winters in mined twigs, then makes papery white cocoons attached to foliage.

Control. A nicotine-oil spray applied in May.

Cypress Webbers (*Epinotia subviridis* and *E. cupressi*)—On cypress in California. Brownish-green larvae with light tubercles, ⅖ inch long, eat leaves and tie them up with twigs in a sort of nest; foliage may turn brown; chief injury is in February and May.

Control. Use nicotine-oil spray in May (a 1 to 50 dilution of Volck plus 1 teaspoon nicotine sulfate per gallon).

Diamondback Moth (*Plutella maculipennis*)—A European species widely distributed here for the past 100 years. This is listed as one of the minor cabbage worms but it has been most seriously damaging crucifers—cabbage, broccoli, collards, and kale—in the truck-crop areas of Virginia. It may also feed on Brussels sprouts, cauliflower, horseradish, mustard, radish, turnips; and is quite a greenhouse (sometimes a garden) pest on sweet alyssum, candytuft, stock, and wallflower.

The moths winter under remnants of the cabbage crop. They are small, ¾ inch across, with wings gray or brownish and having white marks which make a diamond when the fore wings are folded. The hind wings are fringed. Yellowish eggs are glued to the leaves, 2 or 3 in one place. Young larvae, greenish-yellow with black hairs, ⅓ inch long, at first mine the leaves, later feed externally. They wriggle actively when disturbed or drop on a silken thread. Pupation is inside a loose lace-like cocoon fastened to the leaf, moths emerging in a week. There may be two to six generations.

Control. Dust with rotenone, preferably with the addition of nicotine in the form of Black Leaf 155.

European Pine Shoot Moth (*Rhyacionia buoliana*)—First discovered on Long Island in 1914, now present in northeastern states west to Michigan, south to Virginia, and there is an unconfirmed Florida report. This insect is almost always present in small ornamental pines, Scotch and mugho varieties particularly, but it is a serious pest of red pine and may attack white pine. (Plate III, page 110.)

The pine shoot moth hibernates as a partly grown larva, brown with a black head, in buds of pine, becoming active with warm weather in spring, when it leaves its winter bud and bores into an uninfested bud or growing shoot. The shoot grows 1 or 2 inches, becomes crooked, straw-colored, dead, usually with a mass of pitch at the point of larval entrance. Infested shoots are very easy to detect. Pupation is in the shoot in May and June, with moths starting to emerge in early or mid-June and continuing until the middle of July.

The moths have reddish-orange fore wings marked with silver cross lines, dark brown hind wings. They are about ¾ inch across. Eggs are laid near the tips of twigs, on bark or in needle sheaths. In 10 days the larva starts boring through needle bases, with needles on terminal shoots turning yellow; at the end of summer the larva moves over to a bud and bores in for the winter.

Control. Infestations in small pines about the house are easily taken care of by breaking off infested shoots in spring before moths emerge, making sure the brown caterpillar is inside the part broken off, dropping everything into a paper bag for disposal by fire. When the pines are too large for such handwork, or are in plantations, the most effective spray is powdered derris or cube, using 2 pounds per 50 gallons of water and adding ½ pound powdered skim milk. A mixture of 1½ pounds lead arsenate plus ½ pint fish oil per 50 gallons of water is almost as satisfactory. The first spray is applied about the first of July (in Connecticut) and the second about 10 days later.

Fern Moth (*Euplexia lucipara*)—A European insect infesting ferns in

greenhouses and residences in various parts of the country and outdoors in California. The moth is medium size, rich velvety maroon. Caterpillars are green or brownish-red. There are two broods a year, with adults first appearing in April (in California) but with most outdoor injury in the fall. Pupation is in a silken cocoon in the soil.

Control with lead-arsenate spray or dust.

Grape Berry Moth (*Polychrosis viteana*)—Generally distributed east of the Rocky Mountains on wild and cultivated grapes, most injurious in the Northeast. This species is found as often on a few vines in the back yard as in the commercial vineyard. Grape berries are webbed together, turn dark purple, drop when about half size. A nearly ripe berry will have a hole and be attached by webbing to a leaf.

The grape berry moth winters in cocoons, usually folded in fallen grape leaves, sometimes attached to loose bark scales. About flowering time the grayish-purple moth, ½ inch across the wings, emerges to lay flat, circular, cream-colored eggs on stems, flower clusters, newly forming berries. The young larvae web parts together as they feed, each worm destroying several berries apiece. Larvae are greenish, with brown heads, ⅓ to ½ inch long. Each larva cuts and folds over a little flap of leaf, and within this spins a cocoon. Moths of the second generation emerge in July; there may be three generations in the South.

Control. Recommended treatment is spraying with lead or calcium arsenate plus fish-oil soap or other spreader in bordeaux mixture, just after the fruit has set and again 10 days later. A third spray, applied when the grapes are half grown, should contain less lead arsenate for fear of residue. In the home garden it may be wiser to bag the grapes, or to substitute rotenone for the last spray.

Grape Plume Moth (*Pterophorus periscelidactylus*)—Common on many back-yard grapevines. Eggs winter in branch crotches on old canes; pale yellow-green larvae enter the buds, then web together unfolding leaves. After the first molt the caterpillars are fuzzy, covered with long yellow hairs. Pupation is in the webbed leaf. The adult moth is brown, with divided wings.

Control. Use a dormant oil or lime-sulfur spray when buds start to swell.

Gypsy Moth (*Porthetria dispar*)—An expensive pest of shade, forest, and fruit trees in New England. In 1868 a scientist at Medford, Massachusetts, lost, due to a windstorm which broke open screened cages, some caterpillars he had imported for improving the breed of silkworms. About 10 years later caterpillars were numerous on trees in that vicinity and in 20 years trees in eastern Massachusetts were being defoliated. An appropriation was made for control but in a year or two the legislature

decided to "economize" and stopped the work. By 1905, when control measures were resumed, the gypsy moth covered 4,000 square miles and the state of Massachusetts alone spends more than a million dollars a year, making up for past economy.

A barrier zone 30 miles wide, extending from Canada to Long Island along the Hudson Valley, has been maintained. Sporadic outbreaks beyond this zone in New Jersey, Ohio, and New York have been eradicated, and there has been an infestation in Pennsylvania. The New England infested area now includes 35,000 square miles, and the barrier zone, or suppressive area, is about 9,700 square miles. Quarantine regulations prohibit the movement of any plant material, stone, or quarry product, capable of harboring gypsy moth eggs, from towns in this suppressive area south or west without examination by state or Federal inspectors.

Gypsy moth defoliation retards growth of many hardwood forest trees or kills them, especially apple, oak, birch, larch, linden, willow, chestnut, hemlock, pine, and spruce. It is devastating to ornamental trees around the house.

The caterpillars are brown, hairy, 2 inches long, with 5 pairs of blue tubercles along the back followed by 6 pairs of red tubercles. (Plate VI, page 119.) They feed in June and July, stripping the trees, pupate inside a few threads spun on limb or tree trunk, and produce moths in 17 or 18 days. The brown, yellow-marked male flies freely; the heavy female does not use her white wings with their wavy dark markings. She lays large oval egg clusters, covered with tan hairs, near the place of pupation, on the tree or any hard surface. There is one generation, the eggs hatching in spring. Distribution is by wind dispersal of young larvae, crawling of caterpillars, or moving of some object, such as an automobile or railroad car, with attached egg cluster.

Control. Spray trees with lead arsenate, catch larvae in burlap bands around tree trunks, paint egg masses with creosote. The parasites imported for this pest, together with the predaceous European ground beetle, are helpful, and the barrier zone maintained by the Federal government and co-operating states is of extreme importance to the rest of the country.

Hag Moth (*Phobetron pithecium*)—One of the slug caterpillars. The larva is more interesting than destructive, brown, about ¾ inch long, with 10 long, tapering, plume-like processes extending from either side of the back like hanks of hair. It is present on leaves of a number of trees from July to September.

Hawk Moth—See **Hornworms.**

Hickory Tussock Moth (*Halisidota caryae*), or **Hickory Tiger Moth**—Found from the Atlantic west to Missouri and Minnesota and south to North Carolina. Mature caterpillars have been seen on 49 different hosts,

but apparently develop on walnut, hickory, butternut, and pomaceous fruit trees. Though not usually important, in some seasons they may cause defoliation.

The moth has light yellow fore wings with 3 irregular rows of transparent light spots, expanding to 2 inches, and thin, colorless hind wings. The caterpillar is covered with dense tufts of gray-white hairs with a row of black tufts along the back. There may be "pencils" of hairs scattered over the body.

Moths appear in June to lay white eggs in patches of 100 or more on underside of leaves. Larvae pass through 8 or 9 instars (periods between molts) and feed for 60 to 90 days before spinning cocoons among leaves or other objects on ground.

Control. Some parasites, an ichneumon wasp in particular, attack the larvae. Arsenate of lead should give control; probably it will not be necessary.

Hornet Moth (*Aegeria apiformis*)—Adults resemble the giant hornet, with brown abdomen banded with yellow, transparent wings with brown borders. They are sluggish moths. Caterpillars are stout, naked, white, with brown heads and rims of spiracles. They make extensive burrows in trunks and large limbs of poplars and willows, causing swellings, often death of young trees. In the West, Balm of Gilead or balsam poplar is most susceptible. The hornet moth is so much of a pest in California that poplars are unsatisfactory for shade trees. Pupation is in burrows; it takes 2 years for one generation.

Imperial Moth (*Eacles imperialis*)—This large moth, expanding to 4 or 5½ inches, is sulfur-yellow, banded and speckled with purple-brown. The caterpillar is 3 to 4 inches long, green with a brown head and yellow, 6-spined horns behind the head. It feeds on hickory, oak, butternut, sycamore, beech, chestnut, birch, white pine, spruce, cedar, cypress, juniper, and other trees.

Control is seldom necessary.

Io Moth (*Automeris io*)—The female adult is purplish-red with a large black eye-like spot on each hind wing, spreading to 3 inches. The male is smaller and deep yellow. The caterpillar is pale green with a broad brown or reddish stripe, underscored with white, along each side of the body, which bears 6 rows of branching green spines tipped with black. The spines are irritating and some people may be poisoned by them. Larvae feed on beech, willow, poplar, oak, maple, birch, ash, sycamore, hickory, sassafras, elm.

Leopard Moth (*Zeuzera pyrina*)—A European species first noted here in 1879, in a spider's web at Hoboken, New Jersey, now present along the coast from Maine to Delaware. It is recorded as feeding on 83 dif-

ferent plants, favored among these being elm, maple, ash, beech, walnut, oak, chestnut, poplar, willow, lilac; apple, plum, pear, and other fruits.

The moths are white with blue and black spots, the female 3 inches across the wings, the male 2 inches; they fly from May to September. (Figure 73.) The female lays up to 800 salmon-colored eggs, singly or in small groups, in bark crevices. The young larvae hatch in 10 days and work their way into heartwood or enter twigs at the base of buds, causing wilting. As they increase in size they make irregular galleries in large limbs and main trunk, feeding for about 2 years before pupation. The borer caterpillars are about 2 inches long when mature, pale yellow with a pinkish tinge and bearing dark tubercles of hairs. Small nursery trees and branches of larger trees die; smaller branches break over and hang down; the bark is full of holes with protruding sawdust.

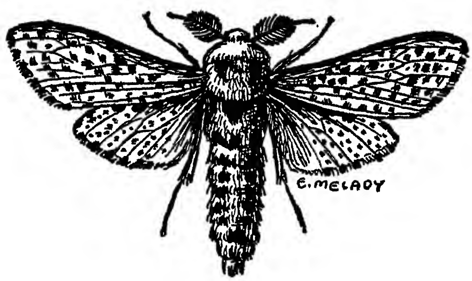


Figure 73

Leopard moth

Control. Use the same methods as for other borers. Inject carbon bisulfide or a mixture of ethylene dichloride and carbon tetrachloride into burrows; cut and burn infested branches during winter months; pick up and burn fallen branches; cut down and burn trees very badly injured.

Luna Moth (*Tropaea luna*)—The lovely adult has delicate green wings expanding to 4 inches, a purple band on front edge of fore wings and an eyespot, hind wings extending into long, narrow swallowtails. The caterpillar is bluish-green with a yellow stripe along each side and a yellow cross line at the joining of each segment. Larvae feed on hickory, walnut, birch, oak, willow, beech, butternut, chestnut, and other trees but are not numerous enough to call for control measures.

Maple Sesian—See **Maple Callus Borer.**

Nantucket Pine Moth (*Rhyacionia frustrana*) or **Pine Tip Moth**—An eastern species which has traveled as far west as New Mexico. This moth is particularly injurious to Virginia and pitch pine along the Atlantic seaboard; may kill lateral shoots of red pine and has damaged jack and yellow pine in nurseries in Nebraska.

The moth is small, ½-inch wingspread, copper-colored; it lays yellow eggs on needles or terminal leaf buds in June. Yellow larvae, up to ½ inch long, mine in needles, then in buds, spinning a web around the needles and finally burrowing down twigs of new growth and pupating there. Adults of the second generation appear in August. Larvae develop and winter as pupae in soil, at least in some cases.

Control. Many different parasites attack the Nantucket pine moth. In ornamental plantings remove and burn infested tips in late May and late August, after eggs have hatched.

Figure 74

Oriental fruit moth injury to peach, and detail of moth and larva

Oriental Fruit Moth (*Grapholitha molesta*)—Found in eastern states where peaches are grown and also in the Southwest. Coming in from the Orient on nursery stock sometime prior to 1915, this moth is in many sections the most important peach pest, threatens the quince industry, and is often obnoxious on apple, pear, apricot. In California cherry, plum, and Chinese hawthorn have recently been added to the list of food plants. First indication of injury in spring is blackening and dying back of new growth. (Figure 74.) Fruit injury is similar to that of codling moth in apple, but because the worm enters through the stem there may be no external sign of injury until breakdown after picking reveals numerous feeding burrows. In addition to feeding injury the worms also spread the brown rot fungus.

Full-grown larvae winter in cocoons, in rubbish, weeds, or mummied fruit on ground; pupate in spring. Moths, gray with chocolate-brown markings on wings, which spread only ½ inch, lay flat, white eggs on leaves or twigs shortly after peaches bloom. First-brood larvae attack growing tips, which die. Larvae of later broods attack both young shoots

and fruit. There may be one to seven generations with an average of four in New York. The worms are pinkish-white, with brown heads, ½ inch long.

Control. Feeding habits make the usual control methods unsatisfactory. DDT kills adults and larvae, appears promising in field tests, but it does delay ripening of fruit. A dust formula—60 per cent sulfur, 35 per cent talc, 5 per cent mineral oil—has given fair results if used at 5-day intervals, starting about 20 days before harvest. Other methods include planting of early-maturing varieties, periodic and frequent clipping of infested twigs, cultivating soil 4 inches deep 1 to 3 weeks before blooming to kill overwintering larvae, or use of paradichlorobenzene as for peach-tree borer to kill larvae near trunks, prompt destruction of cull fruits. Parasites liberated in many areas seem to be quite effective.

Oriental Moth (*Cnidocampa flavescens*)—A Japanese insect found around Boston in 1906 and still limited to a radius of 15 miles around that city. The caterpillars have yellow, blue, green, and purple markings, are ⅞ inch long, feed on Norway maple, sycamore, buckthorn, black birch, wild cherry, sometimes on oak, poplar, willow, hickory, hackberry, honey locust. The moth has wings spreading from 1¼ to 1½ inches, yellow on the inside, reddish-brown in outer portion, with dark fringes. They appear in late June and July, lay oval eggs on undersides of leaves. The larvae pupate in hard cocoons in limb crotches; there is one generation.

Control. Native and introduced parasites are holding the oriental moth in check. Young larvae can be killed with arsenate-of-lead spray.

Pale Tussock Moth (*Halisidota tesselaris*)—Present in Atlantic states. The adult is pale green with light brown spots, has thick, orange-yellow hairs on abdomen. The 1¼-inch-long caterpillar is sparsely covered with yellow-buff hairs, has dense tufts of yellow-gray hairs, 3 pairs of black "pencils" of hairs, a dark line down the middle of the back, and a brown head. It feeds on maple and other trees.

Pandora Moth (*Coloradia pandora*)—Present in western pine belts. Moths have brownish-gray fore wings with a spattering of white scales, black lines with a black spot, pinkish hind wings with black margins, and 1 black spot on each wing. Flattened green eggs are laid in clusters on bark of pine trees in spring. Caterpillars, appearing in August, are dark when young, green to brown, leathery, when mature. They are for the most part timber pests, often defoliating large areas of yellow and Jeffrey pines. There is a 2-year life cycle.

These caterpillars have been used for food by Paiute Indians, who smoke the worms down, dry them, and later make them into stew. Other tribes roast the pupae.

Pea Moth (*Laspeyresia nigricana*)—A serious pest in northern pea-

canning areas, sometimes a garden trouble. The pea moth has been present since about 1900, attacks all varieties of field and garden pea, sweet pea, and vetch. Growing peas have irregular cavities eaten out of sides; seeds are spoiled and pods are partly filled with pellets of excrement and caterpillar silk; they may turn yellow and ripen prematurely. Inactive larvae winter in silk cocoons covered with soil particles just below the soil surface or in cracks and crevices around barns. They change to brownish pupae in late spring when peas come into blossom (July in very northern areas).

Small brown moths, marked with black and white lines on the fore wings, are active about plants in late afternoon, laying minute, flattened white eggs singly on pods, leaves, flowers, or stems, or on other near-by plants. On hatching, young larvae drill into pods, are full-grown in 2 to 4 weeks; they are yellow-white with small dark spots, pale short hairs scattered over the body, dark areas at each end, and are ½ inch long. They eat their way out of pods and make cocoons in soil. Some larvae transform to moths for a second generation, others remain in soil until the next spring.

Control. Sanitary measures are about all that are available: deep plowing in spring, early varieties, early planting to avoid most of the injury, burning all crop remnants, disking the soil after harvest.

Pine Tube Moth (*Argyrotaenia pinatubana*)—Widely distributed, attacking white pine in the East, lodge pole pine in the West. Moths have rust-red fore wings, with 2 white oblique lines across each, silky gray hind wings, ½-inch wingspread. They emerge in late April, are around in May and June. Larvae are greenish-yellow with a faint dark line down the back, ⅓ inch long. They make tubes by tying needles together side by side, squarely eating off the free end. The tubes stand erect and may be quite conspicuous; pupation in October is in these tubes.

Control. During the winter clean out tubes by hand and burn. Parasites keep the tube moth in check most of the time.

Pitch Twig Moth (*Petrova comstockiana*)—The moth is small, wing expanse 1 inch, dark with light gray markings; the caterpillar is yellow with a brown head, ½ inch long. It infests small branches and twigs of pitch pine, burrowing in wood and sometimes girdling twigs, leaving a thick mass of pitch at the point of entrance. Cut out such twigs.

Polyphemus Moth (*Telea polyphemus*)—One of the giant silkworms. It has a spread of 5 to 6 inches, brownish-yellow wings crossed with a dusky band edged with pink, and a large eyespot on each hind wing. The caterpillar is 3 inches long, light green with an oblique yellow line on each side of each abdominal segment except the first and last, and with small reddish tubercles. It feeds on oak, elm, sassafras, wild cherry, ash,

sweet gum, maple, poplar, lilac, birch, and other trees but is rarely injurious.

Promethea Moth (*Callosamia promethea*)—The most common of the giant silkworms. The female has light reddish-brown wings, crossed near the middle with a white wavy line and with an angular discal spot, spreading to 3 inches. Each fore wing also has an eye-like spot near the tip. The male has dark brown, nearly black wings, with light brown borders and a zigzag line. The caterpillars are 2 or more inches long, pale bluish-green with rows of black, polished, wart-like tubercles, 2 larger coral-red pairs of tubercles on second and third thoracic segments and a yellow pair on the eighth abdominal segment. They feed on lilac, wild cherry, tuliptree, ash, sassafras, and other plants. The cocoon is long, spindle-shaped, enclosed in a leaf.

Regal Moth—See **Hickory Horned Devil** under Caterpillars.

Rusty Tussock Moth (*Notolophus antiqua*)—A European species found in parts of the eastern United States and on the Pacific coast. It is a pest of apple, quince, and other fruits, may feed on beech, mountain-ash, birch, poplar, willow, and some other trees. The male moth has brown wings marked with grayish lines, a white spot near the hind border of each wing; the female is gray and wingless. The caterpillar is like the white-marked tussock moth, which see, except that the head is black, there are 2 extra pencils of hairs in the middle of the body, and no yellow lines.

Saddled Prominent—See under **Caterpillars.**

Satin Moth (*Stilpnotia salicis*)—A European insect noted in Massachusetts in 1920, present now throughout New England and in the state of Washington, reported at Albany, New York, in 1944. The larvae defoliate poplars, especially Lombardy poplars, willows, and may feed on oak. It is estimated that from 25 to 60 per cent of Carolina poplars in eastern and central Massachusetts were defoliated by this insect in 1944.

The moths are satin-white, wing expanse 1½ to 2 inches. The caterpillars are black with conspicuous irregular white blotches down the back and whorls of hairs. Their ravenous feeding may cause trees to die, and they annoy pedestrians by dropping down on them.

Partly grown caterpillars winter in small webs in bark crevices, start feeding in late April or May. After a month they pupate among leaves, rubbish, or in bark crevices; the moths emerge in July to lay eggs in white glistening clusters on trunk, branches, and leaves. The caterpillars, coming out in 2 weeks, grow so slowly that they are not full-size before winter hibernation.

Control. Paint egg clusters promptly with creosote. Spray foliage in spring with arsenate of lead, plus fish oil added as a sticker, unless trees are too near buildings.

Sequoia Pitch Moth (*Vespamima sequoiae*)—Opaque, dirty-white larvae infest branches and bases, mine the cambium layer of knobcone, lodgepole, Monterey, and yellow pine, Douglas fir, redwood, and other conifers in Montana, Washington, Oregon, and California. The moth looks like a yellow-jacket wasp, black with the last segment of abdomen bordered with bright yellow.

Snapdragon Plume Moth (*Platyptilia antirrhina*)—Small greenish larvae at first mine leaves, then feed openly on terminal leaves and bore inside developing flowers, seeds, and inside main stems. Mature caterpillars are green or purplish-red. Naked pupae are suspended from any part of plants, giving rise to grayish-brown moths, wingspread only 1/3 to 4/5 inch. Netted ovate eggs are laid singly anywhere on plants. There are three generations a year outdoors in California, more in greenhouses.

Control. Spray with a 1 per cent light oil emulsion in a 1 to 400 dilution of pyrethrum or use pyrethrum dust.

Snowberry Clear-wing (*Hemaris diffinis*)—The caterpillars are hornworms feeding on snowberry and Tartarian honeysuckle. They vary from light to dark green to brown, or purplish, and have prominent spiracles. The moths have clear, transparent wings with dark brown margins, spreading from 1 1/2 to 2 inches, and a black body marked with gold. There are two generations each season; eggs are laid on food plants; hibernation is as pupae in soil.

Control. Hand-picking is usually sufficient. Spray with lead arsenate if needed.

Snow-white Linden Moth—See **Elm Spanworm.**

Sphinx Moths—See **Hornworms.**

Spotted Tussock Moth (*Halisidota maculata*)—Present in North Atlantic states, usually on oak, sometimes on willow, boxelder, and other deciduous trees. The moths are about 2 inches across, have dark yellow fore wings marked with bands and spots, unspotted nearly transparent hind wings. Larvae are 1 3/8 inches long, with tufts of yellow hairs in the middle of the body, black hairs at both ends, a line of black spots along the back, and a few long whitish pencils of hairs. See White-marked Tussock Moth for control.

Spruce Epizeuxis (*Epizeuxis aemula*)—Brown larvae covered with tubercles web spruce needles together as they feed. Moths are brownish-gray, with wings crossed by narrow waxy bands, spreading less than an inch.

Strawberry Crown Moth (*Conopia bibionipennis*)—Known in various regions, most common in the Northwest. White to yellowish larvae, 1/2 to 3/4 inch long, bore in the crown, as many as 50 borers sometimes working in a single plant. The foliage turns yellow, recent transplants die,

older plants are much weakened. Raspberries and blackberries are also infested. The adult is a clear-wing moth resembling a yellow-jacket wasp. Nearly mature larvae winter in strawberry crowns, pupate in May; the moths emerge in June and July, laying eggs on lower leaves; there is one generation a year.

Control. Pull and burn infested plants in spring before moths emerge; top plants after harvest by cutting off leaves, stems, runners, old fruit spurs to stimulate new growth and vigor. Cover bed with straw after topping to prevent egg-laying; leave trap rows to encourage egg-laying and then plow these under or burn in the fall to destroy larvae.

Striped Morning Sphinx—See **White-lined Sphinx.**

Sycamore Tussock Moth (*Halisidota harrisii*)—Sometimes present on sycamore trees but rarely numerous enough to cause trouble. The caterpillar is hairy with 2 long white pencils of hairs at the posterior end of the body, several white pencils and 2 black ones at the head end.

Verbena Moth—See **Verbena Budworm.**

Virginia Tiger Moth—See **Yellow Woolly Bear** under Caterpillars. In addition to garden plants this species sometimes feeds on butternut.

Western Tussock Moth (*Hemerocampa vetusta*), commonly known as **California Tussock Moth**—Present along the Pacific coast from southern California to British Columbia. The female is gray, wingless; the male has brown wings with gray markings. Eggs are laid in felty gray masses on old cocoons or bark of host plants—apple, almond, apricot, blackberry, California Christmasberry, California coffeeberry, cherry, hawthorn, manzanita, oak, pear, plum, prune, walnut, willows. The caterpillars are gray with red, blue, and yellow spots, 4 white tufts of hairs in the middle of the body, 1 white and 1 black tuft at the end, and 2 long black tufts, looking like horns, at the head; ¾ to 1 inch long. They feed on leaves and young fruit. There is only one brood, eggs being laid in late summer and fall, staying on trees during the winter, hatching when leaves unfold in spring. Adults are present in May, June, and July.

Control. Remove egg masses during the winter; jar caterpillars from trees and prevent return by banding as for cankerworms. Spray with oil just after eggs hatch to kill young larvae. Pyrethrum sprays are helpful in protecting young fruit.

White-lined Sphinx (*Celerio lineata*), also called **Striped Morning Sphinx**—The commonest western member of the sphinx family, but occurring throughout the United States. Principal hosts include apple, azalea, beet, collards, currant, elm, fuchsia, gooseberry, grape, melon, pear, plum, portulaca, prune, tomato, turnip, and other truck crops and weeds. The hornworm larva is especially troublesome in Florida on beets and tomatoes.

The moths have dull brown bodies marked with white and darker brown spots, fore wings with white-lined veins and a broad buff stripe; dark hind wings with a wide rosy band across the middle of each. The moths, like those of the tomato hornworm, resemble hummingbirds and appear at dusk to visit columbine, honeysuckle, petunias, and other flowers. The caterpillars, 2½ to 3½ inches long, are usually green with yellow head and horn, pale spots bordered with black, but sometimes the larvae are black with yellow or orange head and horn and 3 yellow lines on the back. Pupation is in soil, in shiny, dark brown chrysalids. There are two broods.

Control. Spray with weak arsenate of lead plus casein spreader when young larvae start feeding.

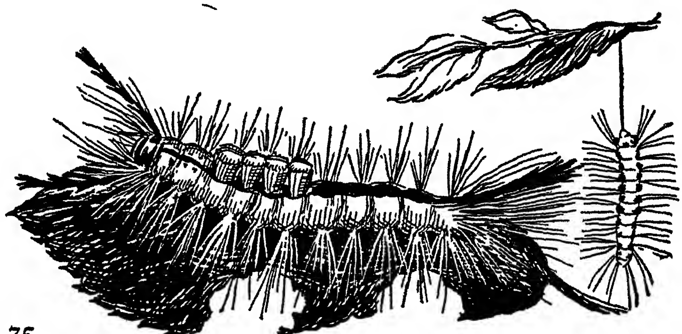


Figure 75

Larva of the white-marked tussock moth

White-marked Tussock Moth (*Hemerocampa leucostigma*)—A native insect, common in the East, ranging west to Colorado. Favorite food plants are fruit and shade trees—apple, pear, quince, plum, elm, linden, maple, horsechestnut, poplar, sycamore, buckeye, willow, and many other deciduous ornamental trees; but not evergreens. This is primarily a city pest. Foliage is skeletonized and fruits scarred by conspicuous hairy caterpillars, 1½ to 1¾ inches long, with red heads, 2 pencil-like tufts of long black hairs projecting like horns, a third tuft at the rear, a black stripe down the middle of the back bordered with a wide yellow line, 4 white brushes or tussocks of hairs on the first segments of the abdomen. (Figure 75.)

The female moth is nearly wingless, gray, hairy; the male has brownish wings marked with shades of gray and cross lines near the outer margins, spreading to 1⅜ inches, and feathery antennae; legs tufted with white hairs. Eggs are laid in fall in conspicuous masses about an inch long containing 50 to 100, covered with a white lathery substance, on trunk, branches,

dead leaves, or on top of the cocoon from which the female moth emerged. Caterpillars feed in June and July, pupate in cocoons on trunk and branches; moths emerge to lay eggs for a second generation feeding in August and September.

Control. A great many parasites work on this insect, but unfortunately there are also a number of hyperparasites which live on the parasites. Many birds eat the caterpillars in their young stages. Trained tree experts often climb trees to scrape off egg masses or to daub them with creosote containing a little lampblack, to mark those treated. A lead-arsenate spray timed for elm leaf beetles and cankerworms will also control tussock moths.

White-pine Shoot Moth (*Eucosma gloriola*)—A recent New England pest, attacking lateral shoots of white pine in early summer, causing wilting. Tips bend over, foliage turns yellow, then brown. The caterpillar is white, ½ inch long, burrows in center of shoots which die back 6 to 8 inches from the tips.

Control. Cut off and burn infested tips as soon as noticed.

Yucca Moth (*Tegeticula yuccasella*)—Responsible for the pollination of yucca plants; a southwestern species. The female has specially modified mouth parts with which she scrapes together pollen from the stamens and carries it with her to another flower where she lays eggs through the wall of the ovary into the seed cavity.

Zimmerman Pine Moth (*Dioryctria zimmermani*)—Preferring Corsican and Scotch pines but sometimes feeding on Austrian and red pine. In western United States it also feeds on other pines and Douglas fir. The caterpillars work near the tips of new shoots, dwarfing needles, and build small tubes of pitch at the base of injured parts. Entire tops of trees may break off.

There is as yet no satisfactory control, so Scotch pine as an ornamental is declining in popularity in areas where the Zimmerman moth is present.

NEMATODES

Nematodes are microscopic worm-like animals, tubular or thread-like in form, belonging to the animal phylum Nemathelminthes, and called also nemas, eelworms, or roundworms. They live in moist soil, water, decaying organic matter, and tissues of other living organisms. They form a part of the natural soil fauna. Some nematodes cause diseases of man or animals, others cause plant diseases, and still others are beneficial because, like the nematodes parasitic on Japanese beetles, they live on harmful insects.

Nematodes can move through the soil by a kind of threshing motion,

but rarely travel more than about 30 inches a year. Any dissemination of eelworms to a greater distance normally involves movement of infested soil or plant parts or surface water. Nematodes have a hollow, spear-like organ, called the buccal spear, with which they suck plant juices from living cells. There are 3 very important nematodes infesting garden and greenhouse plants: the leaf nematode, the root-knot nematode, often a limiting factor in southern gardening, and the stem and bulb nematode. Others, such as the cereal and grass nematode, sugar beet nematode, cotton and potato nematode, are important to farmers.

Figure 76

Leaf nematode injury on chrysanthemum—usually a dark, sometimes a tan, wedge-shaped area on the leaf

Leaf Nematode (*Aphelenchoides fragariae*)—Probably synonymous with, or a strain of, *Aphelenchus olesistus* and *Aphelenchoides ritzema-bosi*, but the taxonomy is confused. This nematode is the cause of brown wedges in chrysanthemum leaves, followed by drying of foliage progressively up the stem, reddish to black bands across fern fronds, discolored begonia leaves and stunted plants, deformed flower clusters and blotched leaves of bouvardia, dark brown or black blotches in anemone leaves, brown areas bounded by larger veins in orchid leaves, spotting of African violet foliage, and sometimes death of distorted plants, shortened stalks of zinnia, conspicuous brown areas on calceolaria and coleus, lower leaves of lantana killed with brown blotches on upper leaves, similar symptoms on doronicum, moonflower, and salvia.

The nematodes swim in a film of water from the soil up the stems and from leaf to leaf, entering through stomates (leaf pores) in wet weather. The browning and discoloration of plant tissue is bounded by larger veins so that it is more or less wedge-shaped. The shape of the dead tissue more than any other symptoms separates nematode work from a fungus disease. Since the nematodes start from the ground, leaves die and shrivel, get brittle, and drop progressively, beginning at the bottom. Normal bloom may be prevented.

For many years this nematode was considered a greenhouse pest, but for the past decade or so it has nearly wrecked outdoor chrysanthemum plantings all over the country—undoubtedly the most serious enemy of chrysanthemums. It seems particularly destructive to Korean varieties but is by no means limited to them. (Figure 76.)

Control. Since eggs and worms live over winter in old parts of infested plants, seriously injured specimens should be removed and burned. Add all old chrysanthemum tops to the fall bonfire, never add them to the compost heap. Avoid cultivating or handling plants when the foliage is wet.

Frequent treatments with a spray combining nicotine sulfate with bordeaux mixture is recommended to kill young nematodes and to act as a repellent, but this means garden plants will be much disfigured by spray residue. I'd rather take a chance on nicotine without the bordeaux.

Rotating chrysanthemum plantings is a help. If there is no uninfested soil for healthy plants old beds can be treated with formalin or chloropicrin or carbon bisulfide or the new DD (see Root-Knot Nematode). Commercial growers can sterilize plants by immersing in hot water held at 115° F. for 15 minutes. A half-inch mulch of tobacco dust kept on beds is said to help.

An old treatment for greenhouse plants, not too practical, is syringing of foliage with warm water to bring out the worms, and then spraying with water to which 0.5 to 1 per cent ammonium solution has been added.

A new remedy for leaf nematodes is addition of sodium selenate to the soil as used for common red spider (which see). This is not yet advised for amateur use in outdoor plantings.

Root-Knot Nematode (*Heterodera marioni*)—Attacking at least 1,300 species of plants, causing them to wilt, turn yellow, die back branch by branch. Examination of roots, provided soil is loosened and plants are pulled up carefully, will show small roots and rootlets enlarged in a great many plants into round or elongated galls or knots. (Figure 77.) They are an actual part of the root, not readily detached as are the nodules produced by nitrogen-fixing bacteria on legumes.

Nematode larvae attack a rootlet near the growing tip. The males stay thin as a hair, practically invisible except under a microscope; the females become shiny white, swollen into gourd shape, about as big as a pin point, and sometimes just barely visible. They deposit 500 to 1,000 eggs in a yellow jelly which darkens to reddish-brown or black. Fertilization by a male is not always necessary. When the larvae hatch, nearly all leave the gall in which they were produced and migrate through the root or into the soil in search of fresh rootlets.

The root-knot nematode develops at any temperature between 50° and

90° F. It is usually killed in the soil during northern winters (2 hours at 0° F. will do the trick), but survives in greenhouses and often comes up from the South in spring on tomato seedlings. The life cycle lasts from 16 to more than 100 days, according to temperature, the most rapid development being at an average of 81° F. Because of this temperature relation, root knot is never the tremendous and discouraging problem in the North that it becomes in southern states, where the organism may rest through cooler winter months but is never killed except by starving it out with one of the few resistant crops, grown for a couple of years between susceptible plantings. Although the nematodes require living plants for reproduction they survive for many months in the soil in a state of suspended animation. They are most prevalent in sandy soil.

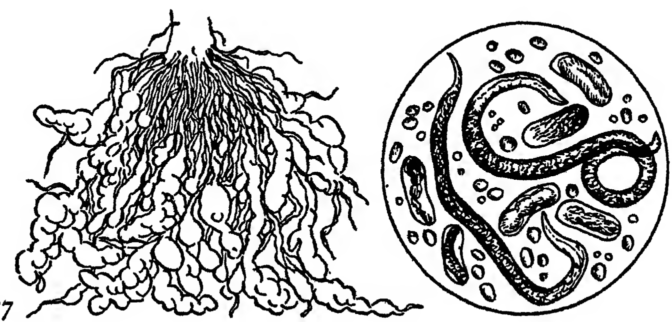


Figure 77

Root-knot nematode, showing knots or galls on tomato roots, and nematodes as seen under the microscope

Almost all truck crops, most ornamental flowers, many trees and vines will die or be seriously injured when planted in soil heavily infested with nematodes.

Some of the most susceptible vegetables are bean and most other legumes; beet, cabbage, and other crucifers; carrot, cucumber, and other cucurbits; eggplant, endive, lettuce; lima bean except Hopi variety; melon, okra, parsley, pea, peppers, Irish potato, pumpkin, squash, sweet potato, and tomato. Fruit and nut crops include banana, fig, grape, papaya, peach, pecan, pineapple, plum, strawberry, and black and English walnut. An abbreviated list of ornamentals includes begonia, buddleia, calendula, carnation, catalpa, chrysanthemum, cineraria, clematis, coleus, cyclamen, dahlia, echeveria, elm, gardenia, gourds, hibiscus, hollyhock, hydrangea, lobelia, mulberry, pansy, peony, petunia, rose, snapdragon, sweet pea, tuberose, violet, weeping willow.

Even in the North I have found clematis roots covered with root-knot galls and peonies doing poorly, while nematodes in many northern gardens deform carrots so much that a firm tapering root is impossible.

Other plants will grow fairly well even though infested by root-knot nematodes, and there is a short list of plants that are quite resistant to nematode attack. In the latter group are most grains and grasses, Crotalaria, 1 or 2 varieties of cowpea, lespedeza, sorghums, Laredo variety of soybean, some velvety beans, certain sweet-potato varieties, apricot, avocado, some cherry varieties, citrus plants (rarely slightly infested), date, 1 or 2 varieties of peach and plum, pistachio. For flowers, evening primrose, gaillardia, lupine, marigold, Michaelmas daisy (hardy aster), rudbeckia, and zinnia. Azaleas and euonymus are considered somewhat resistant.

Control. With so many plants, and an almost equal number of weeds susceptible, it is easy to get garden soil heavily infested with root-knot nematodes but very difficult to get rid of them. Susceptible annuals can be rotated in different parts of the garden and a grain or cover crop grown for a couple of years in the old bed to starve out the nematodes. Ornamental shrubs which must remain in one location should be planted only in clean soil.

Fallow soil can be disinfested by treating with chloropicrin, or tear gas, sold as Larvacide (follow manufacturer's directions); or with carbon bisulfide injected into holes 6 to 9 inches deep, staggered 18 inches apart; or formalin, at a 1 to 50 dilution, applied at rate of ½ gallon per square foot; or with DD Mixture. This new soil fumigant is so promising that it is rapidly getting out of the experimental stage and ready for general use. The yield of vegetables planted on treated soil has increased enormously with DD. For the small garden, holes can be punched in rows or beds with a broom handle 10 to 12 inches apart and 5 to 6 inches deep. About ⅓ ounce or 5 to 10 cubic centimeters of DD are used per hole which is then closed with soil. The ground is safe for planting in about 2 weeks.

Greenhouse soil can be steam-sterilized and infested plants can be treated with hot water before being returned to the clean soil. Pick as many galls off roots as possible and then preheat them for 5 minutes in water held at 85° to 95° F.; then immerse in hot water held at 113° for 30 minutes. A higher temperature takes a shorter time, but many plants may be injured. The treatment is tricky anyway, and best left to the professional grower.

In southern gardens it has been found that plowing or spading fallow soil every week or two during the hot months of July and August will kill enough nematodes, exposed to the rays of the sun, to make possible another crop of susceptible plants.

Stem and Bulb Nematode (*Ditylenchus dipsaci*)—Causes a ring disease of bulbs and various stem abnormalities of other plants. On phlox

the nematode enters through stomata of young shoots, working upward as stems develop. Stem tissues and leaves take on all kinds of abnormal forms—thread-like, spindling, wrinkled, or curled. Stems are bent sidewise, plants are stunted, fail to bloom, die prematurely. Some varieties are very susceptible, others remain quite free from trouble. Nematodes infest seeds of phlox and some other composites and may be disseminated by this means.

Similar symptoms are produced on anemone and primrose. Foxglove leaves show angular brown areas similar to those caused by leaf nematodes; lower leaves of orchids turn brown and brittle.

On bulbs, especially narcissus, nematode injury is called ring disease; when a bulb is cut in half, infested scales appear in dark circles contrasting with the normal white of healthy scales. Badly infested bulbs either do not grow in spring or fail to form flowers; leaves are twisted and have small yellowish swellings. In this country tulips have only recently been added to the list of bulbs attacked, which includes hyacinth, amaryllis, snowdrop, chionodoxa, grape hyacinth, bulbous iris.

On onions, nematode infestation is known as onion bloat or eelworm rot. It has been reported from many counties in New York and is probably present in other states. Inner bulb scales are enlarged, causing a break in outer scales, a split onion that seldom flowers, sometimes a rot at the base. Seedlings are stunted, twisted, covered with yellowish spots. The same nematode infests garlic, salsify, parsley, celery, parsnips, and rye, and is known to persist in soil a long time.

The stem and bulb nematode was first described in Europe in 1877 but apparently has been present in this country for a great many years. There is no dependable evidence to show that it was introduced here from Europe on infested bulbs. It may have been the other way around.

Control. Hot-water treatment is standard for infested bulbs but may impair the flowering ability and is not always desirable. Bulbs should be treated 3 to 5 weeks after digging: pack loosely in wire baskets and immerse in a tank of water held constantly at 110° to 111.5° F. for 4 hours for large bulbs, 3 hours for small. To prevent spread of basal rot, a fungus disease, formalin is added to the water (1 pint to 25 gallons), or the bulbs are dipped in Semesan after the hot-water treatment. Such a procedure is for the commercial grower or the amateur who goes in for bulb production on a large scale. I have met one California gardener, growing narcissus as a hobby, who has the proper equipment and time to supervise this exacting procedure.

Other amateurs will be content with discarding any noticeably infested bulbs before planting and choosing land free from previous infestation. Phlox and other composites showing signs of nematode infestation should

be immediately taken up and burned, and new plants put in another part of the garden or in soil which has been treated (see root-knot nematode).

NEWTS

Newts are tailed amphibians, related to salamanders, and look something like lizards; they are equally useful as destroyers of insects. They are not garden pests. As amphibia they live part of their lives in water, starting as fish-like larvae, breathing by means of gills and changing to lung-breathing adults living on land. There are 2 common newts in North America. The crimson-spotted newt, common in northeastern states, is about 3½ inches long, greenish-brown above, with 2 rows of crimson dots; orange, spotted with black below. The western species is larger, sometimes 6 inches long. They have smooth skins, not scaly like those of reptiles, the snakes, and true lizards.

ORTHEZIA

Greenhouse Orthezia (*Orthezia insignis*)—A scale insect common in greenhouses, sometimes called lantana bug for its predilection for that plant in the tropics. It may infest 125 or more varieties of greenhouse plants, preferring coleus and lantana but also enjoying cacti, heliotrope, petunia, silverlace vine.

The chief characteristic of this sucking insect is the possession of white plates covering the body, usually in a symmetrical pattern. The nymph is dark green, wingless, and about the size of a pinhead, with a white waxy fringe around the body. The female adult has a white, waxy, fluted sac extending backward in a plate two or more times the length of the body, somewhat in the manner of the cottony cushion scale but narrower and not so fluffy. Even including the egg sac, the female is only 1/16 inch long.

Control. Contact insecticides, either nicotine sulfate or pyrethrum, are helpful, as is cyanide fumigation of the greenhouse. See Mealybugs and Scale Insects for details and other suggestions.

PHYLLOXERA—See under **Aphids.**

PINWORMS

Pinworms belong to a very large family of small moths (Gelechiidae) recognized by the pointed outer angle of the hind wings. The larvae vary

in habits. Some, like the eggplant leaf miner, mine in foliage, some feed in rolled leaves or in seeds; one species is the potato tuberworm. The species on tomato is called pinworm.

Tomato Pinworm (*Keiferia lycopersicella*)—Found outdoors in the far South and in southern California, where it is one of the worst tomato pests, and in greenhouses. The larvae, yellow, gray, or green, purple-spotted caterpillars, only 1/4 inch long, make serpentine or blotch mines in leaves, which are folded and held together by light webs. Developing buds and ripening fruits have pinholes bored in them, with entrance usually at the stem end. Injury to vines is not serious, but that to fruits represents a total loss. Adults are small gray moths.

Control. Destroy promptly after harvest all vines and crop remnants, all volunteer host plants and related weeds. Cryolite dust applied to vines is recommended in California and a mixture of pyrethrum and rotenone in Virginia.

PSYLLIDS

Psyllids belong to the family Chermidae (formerly Psyllidae) of the order Homoptera. They are related to aphids, often known as jumping plant lice. They are small sucking insects, usually under 1/4 inch long, with hind legs enlarged for jumping. The adults are very active, quickly jumping away when disturbed. They feed on plant juices, and some species are serious pests—the pear psylla to the fruit grower, potato psyllid to potato growers in many sections, and the boxwood psylla common in home plantings.

Apple Sucker (*Psylla mali*)—Recently found in North America. Eggs are laid on apple twigs in fall and hatch as buds open. Psyllids reach adult stage by June and often leave apples to feed on other vegetables, returning in autumn for egg-laying. The feeding of nymphs, together with a great amount of honeydew, injures opening buds, destroys flower clusters, prevents setting of fruit. See Pear Psylla for control.

Blackberry Psyllid (*Trioza tripunctata*)—Found in the Northeast, a native of wild blackberry, infesting cultivated blackberries and other brambles. The adult psyllid is 1/6 inch long, yellow-brown, each wing marked with three yellow-brown bands. It winters in protected places and soon after growth starts in spring lays eggs in hairs of leaf stems and tender shoots. Nymphs and adults puncture stems, curl leaves, causing stunting and almost gall-like distortion. There is one generation a year.

Control has not been well worked out, but contact sprays as for aphids will help.

Boxwood Psyllid (*Psylla buxi*)—Confined to this host. Terminal leaves

are cupped (Figure 78) and young twig growth checked by a small gray or greenish nymph covered with a white cottony or waxy material. The adult is a very small green "fly" with transparent wings. It appears in early spring, usually April, to lay eggs on tips of new growth so that the distinctive curling and cupping take place as new leaves are formed. The nymphal stage may last until June with adults present in summer. Apparently there is only one brood a year.

Figure 78

Boxwood leaves cupped by boxwood psyllid

Control. It is difficult to reach the insect in its waxy coating inside cupped terminal leaves, but if spraying with nicotine sulfate (1½ teaspoons per gallon), plus soap, is initiated as new growth starts and repeated once or twice, results will be fairly satisfactory. This means spraying 2 or 3 weeks before treatment for the boxwood leaf miner. Recent experiments by Dr. Pyenson suggest that an easier and better way to control boxwood psylla is to spray with a strong nicotine solution in June after the adults are present, spraying well into the bushes. After such treatment the new growth seems to be healthy the next year.

Laurel Psyllid (*Trioza alacris*)—A pest of laurel or sweet bay in California, New Jersey, and other Atlantic states; present also on cherry laurel. Leaves curl and thicken, redden at margins, form galls; plants are very unsightly and often lose much of their foliage. Nymphs are pale yellow and orange, hidden by long white wax; adults are very small, 1/12 inch long, greenish-yellow to pale brown with light and dark spots. Eggs are white to yellow, covered with a fine powdery wax, and are laid in March or April in New Jersey, adults having wintered on or in hosts.

Control. When young are first seen spray with 1 per cent summer oil (Volck) with a teaspoon of nicotine sulfate added per gallon.

Pear Psylla (*Psylla pyricola*)—An important pest of this host. It arrived in Connecticut from Europe about 1832, is now spread over the eastern states, and has been known in Washington and Idaho since 1939. All varieties of pears are attacked, Bartlett and d'Anjou being especially susceptible. Quinces are sometimes invaded. The adult psylla is a dark reddish-brown insect, 1/10 inch long, a minute edition of a cicada with its roof-like wing position. (Plate XXII, page 215.) After spending the winter under bark it starts early in spring to lay elongate, pear-shaped, orange-yellow eggs around buds or in bark cracks. In 2 weeks these hatch into wingless nymphs, only 1/80 inch long, which broaden and darken through 5 molting periods, reaching adult form in about a month.

There are three to five generations a season, with summer eggs laid on leaves or petioles. Nymphs cluster at the axils of leaves and on the underside, secreting copious quantities of sticky honeydew, forming an excellent substratum for the black sooty mold fungus. Infested leaves may fall; the fruit either drops prematurely or is undersized, of poor quality.

Control. The most effective treatment is a delayed dormant spray timed to hit the adults after they move to the twigs but before buds show green. An oil spray, either a lubricating oil emulsion or a miscible oil containing 3 per cent actual oil, or lime-sulfur at a 1 to 9 dilution can be used. Additional contact sprays of nicotine sulfate and soap may be needed during the summer.

Potato Psyllid (*Paratrioza cockerelli*), also named **Tomato Psyllid**—A widespread insect most injurious in the West where it is associated with a disease known as psyllid yellows. The adults are light to dark brown, with black head and thorax marked with white lines and spots, 1/15 inch long. Nymphs are pale yellow and orange, flat, scale-like, margined with a short fringe.

The effect on the potato or tomato varies somewhat with the number of insects present, 10 to 30 being required for full expression of the disease, but even if they feed on only a few leaves, symptoms appear over the whole plant. Basal portions of leaflets turn yellow at margin and roll upward; terminal leaves have a reddish or purple cast; older leaves turn brown and die; stems do not elongate; nodes swell; axillary buds develop into aerial tubers or short shoots with swollen bases and small distorted leaves. The exact nature of this disease is uncertain. Formerly it was considered due to a virus, but present evidence favors the view that the psyllid nymph itself produces the toxic condition by its feeding. This strange power is confined to the nymphs; feeding by adults has no such effect.

The potato or tomato psyllid is present also on alfalfa, arborvitae, spruce, tobacco, datura, nightshade, pepper, petunia, pine. The adults

hibernate in pine trees when possible, feed on groundcherries in spring, then migrate to potato fields where they lay spindle-shaped yellow eggs with a short stipe on either surface of young apical (tip) leaves. One female may lay 5 to 150 eggs a day over a period of a few days to several months. They hatch in 5 or 6 days and nymphs start sucking, passing through 5 instars in about 15 days. Winged adults are active when the plant is disturbed. They thrive best at 80° F., becoming inactive at 95°.

Control. Spray with lime-sulfur, 1 to 40 dilution, at least twice early in the growing season, or treat with fine dusting sulfur.

Sumac Psyllids—Two species are common on sumac. In the East one (*Calophya flavida*) infests smooth sumac. The immature nymphs are dark gray or black with a narrow white fringe, found on the bark of terminal twigs in winter. The other species (*Calophya nigripennis*) infests shining sumac. The adult has black, opaque wings. A third species (*Calophya californica*) infests sumac in southern California. It is black to brown in color.

Control measures are not suggested.

RABBITS—See under **Mammals.**

RATS—See under **Mammals.**

REPTILES

Reptiles are generally useful members of the garden community. There are, of course, a few poisonous snakes, and no one wants to harbor a rattlesnake even if it does eat mice and other rodents, but most snakes are harmless to man and helpful in getting rid of pests. Lizards are more than welcome garden additions, often kept in greenhouses for their insectivorous habits.

Reptiles (snakes, lizards, turtles) bridge the gap between the amphibious animals—newts, salamanders, and toads, which live part of their lives in water, and part on land—on the one hand, and birds and mammals on the other. Reptiles have lungs and breathe air throughout their lives; their young are born on land but they are cold-blooded like the amphibians, with their temperature dependent on the environment. They have scaly skins and a forked tongue which darts in and out with incredible speed.

True lizards are usually found in southern gardens. The so-called lizards of the North are more often newts or salamanders. Most lizards have long tails, and if they are caught they sometimes leave their tails behind in the hands of the enemy and grow new ones. The little green lizard is

a friendly creature, sunning itself on the front porch near the vines, every so often running out its tongue to collect an insect in an action so fast you can scarcely see it.

RODENTS—See **Mammals.**

ROOT MAGGOTS—See **Maggots.**

ROOTWORMS

Rootworms are larvae of beetles and work on roots of plants, sometimes on plants quite different from those injured by the adults. For instance, the clover rootworm is the grape colaspis; the southern corn rootworm is the spotted cucumber beetle.

Clover Rootworm—See **Grape Colaspis.**

Corn Rootworm (*Diabrotica longicornis*), sometimes called **Northern Corn Rootworm**—It is present from New York to Kansas, causes most injury in the Upper Mississippi Valley, and is restricted to corn, so far as known. Overwintering eggs are laid on the ground in fall, hatch rather late in spring. The larvae, thread-like, wrinkled white worms with brown heads, ½ inch long when grown, burrow through corn roots, making brown tunnels. They leave the roots in July and pupate in soil. Beetles, uniform yellowish-green, ⅙ to ¼ inch long, appear in late July and August, feed on silk of corn and pollen of other plants, lay eggs in cornfields in early fall, and die at the first heavy frost.

Control. Rotate corn with any other crop.

Cranberry Rootworm (*Rhabdopterus picipes*)—Important in the beetle stage on rhododendron, apparently not very serious as the rootworm on cranberry. It is a brown or chestnut oval beetle, about ¼ inch long, hiding among leaves and rubbish on the ground, coming out to feed on cloudy days or at dusk or during the night. The feeding, especially on young rhododendron leaves, is most characteristic, appearing as right-angled holes or as crescents. Supposed to be most serious as a nursery pest, but many rhododendrons in established plantings show leaves with this special feeding pattern.

Control. Spray with arsenate of lead, 1 ounce to 2 gallons of water, about the middle of June, and repeat in July if necessary.

Grape Rootworm (*Fidia viticida*)—Present in eastern states, except the extreme North and extreme South, on grape and related wild plants. Small, curved, brown-headed grubs winter deep in the soil, migrating back near the surface in spring, there changing to very soft white pupae in small cells. About 2 weeks after the grapes bloom, brown or gray

chunky beetles, ¼ inch long, feed on upper side of grape leaves, making conspicuous chains of small holes. They lay eggs in clusters on grape canes, often under loose bark. Young grubs drop to the ground, burrow in soil until they reach the roots, then cut off small feeding roots and gouge channels in larger roots until cold weather. Infested vines lack vigor, have little new growth, and have yellow foliage.

Control. Spray foliage with lead arsenate alone or in bordeaux mixture, or with cryolite, as soon as any sign of feeding is noticed. Shallow cultivation of soil up to the time adults emerge in June will destroy many pupae.

Southern Corn Rootworm—See **Spotted Cucumber Beetle.**

Strawberry Rootworm (*Paria canella*)—Found over much of the United States on strawberry, raspberry, blackberry, grape, rose, peach, apple, walnut, butternut, wild crab, mountain-ash, and several other hosts. Roses in greenhouses or outdoors are sometimes riddled with small holes like shot holes, with bark of new growth gnawed off, buds eaten out. Foliage of strawberries and other fruits may be destroyed.

The beetles are very small, ⅛ inch long, bronze-brown or copper. They winter as adults; lay eggs on ground near plants in April and May. The grubs—small, white, brown-spotted—feed on strawberry roots all spring, then pupate. In California there are two generations. On roses in greenhouses there may be several generations.

Control. Spray roses or strawberries early in the season with lead arsenate. Near picking time use derris dusts of 1 per cent rotenone content on strawberries.

Western Grape Rootworm (*Adoxus obscurus*)—Present on grape in California with fireweed as the native host. The beetle is fat, nearly black, covered with short gray hairs. It eats chain-like strips in leaves and gouges into young berries. The white grubs eat smaller roots entirely, and the bark off larger roots.

Control. Spray foliage with an arsenical or cryolite when beetles appear in spring.

SALAMANDERS

Salamanders are amphibians like newts, frogs, and toads. As larvae they live in or near the water and breathe by means of gills; as adults they are terrestrial, though they usually live in damp places and breathe through lungs. They have tails and look much like lizards but they have smooth, moist skin instead of scaly skin.

The true salamanders, members of the genus *Salamandra,* are European, but there are several tailed amphibians in America belonging to

the same family and called salamander—the tiger salamander, living on land in damp places as an adult; the blotched salamander, found in dry and rocky country; the blue-spotted salamander of the mountains; and the dusky salamander, living in fast-moving water.

I frequently get letters asking how to control the "lizards" found under damp stones in the garden. They are probably salamanders or newts, and the answer is, "Leave them alone. They are not garden enemies, and are probably of some help in eating insects."

SAWFLIES

Sawflies belong to the insect order Hymenoptera, along with bees and wasps. As members of that order, the adults have 2 pairs of transparent wings which are hooked together. As members of the suborder Chalastogastra the females have ovipositors (egg-laying apparatus) adapted for sawing or boring but not stinging; the larvae feed on plants, are like caterpillars but with a single pair of ocelli (simple eyes), well-developed legs and prolegs but without any crotchets or hooks on the prolegs. Some sawfly larvae look like minute slugs and are so named—e.g., rose slug, pear slug. Others, like the imported currant worm and pine sawflies, look more like caterpillars. Many sawflies cause trouble in home gardens and most of them can be readily controlled if you start in time, before devastation has gone too far.

Blackberry Sawfly (*Pamphilius dentatus*)—Occasionally blackberry leaves are eaten by bluish-green larvae, ¾ inch long, which roll the leaves, fasten them with a web and feed inside. Adults appear in May, lay white oval eggs end to end on larger veins. The larvae feed until July, then enter the soil to remain until the next May.

Control. Spray with lead arsenate to prevent defoliation.

Brown-headed Ash Sawfly (*Tomestethus multicinctus*)—Reported along the eastern seaboard. White ash, sometimes green ash, may be attacked by this sawfly in sufficient numbers to be defoliated. After wintering as pupae in soil, sawflies emerge in late April and early May to lay eggs in unfolding leaflets. Yellow-white larvae with dark heads feed ravenously, mature in less than 2 weeks, migrate down the trunks and into the soil to make their winter cells.

Control. Spray with lead arsenate at the first sign of young larvae.

Cherry Fruit Sawfly (*Hoplocampa cookei*)—A Pacific coast pest of cherry, plum, prune, sometimes peach and apricot. The adults have black bodies, yellow appendages, are ⅛ inch long. Larvae, white with brown heads, ¼ inch long, work in partly developed fruits and feed on seeds,

then leave through a hole in the side to pupate in a silken cocoon for winter. Fruits wither and drop.

Control. Spray with arsenate of lead just before blossoms open.

Dusky Birch Sawfly (*Croesus latitarsus*)—The adult has a blue-black body with white markings on legs. Larvae occasionally feed in groups around margins of birch leaves.

Control measures are probably unnecessary.

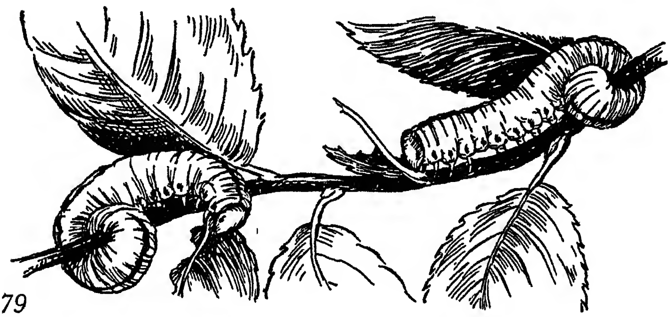


Figure 79

Elm sawfly larvae—note how the rear end is secured to stem

Elm Sawfly (*Cimbex americana*)—Distributed through northern United States into Colorado, with a related species on the Pacific coast. It feeds mostly on elm and willow, but has been recorded on poplar, linden, and maple. The adult is steel blue and black, with 3 or 4 yellow spots on each side of the body, long buff antennae with knobbed ends, smoky brown transparent wings. It is ¾ to 1 inch across the wings, one of the largest of the sawflies. The larva is pale yellow-green with a black stripe along the middle of the back, spiracles making black dots along the body, 8 pairs of prolegs, 1¾ inches when grown, rests in a coiled position. (Figure 79.)

Female sawflies lay eggs in leaf tissue in May, the location of each egg showing as a blister on underside of the leaf. Young larvae crawl out through a slit in the epidermis, feed and grow until late July or August, then crawl to the ground to make a cocoon.

Control. Several parasitic wasps and flies are on the job, so you may not have to spray with lead arsenate.

European Pine Sawfly (*Neodiprion sertifer*)—An introduced species first noted in New Jersey in 1937 and now exceedingly troublesome in home gardens in this state, in part of New York and Connecticut, and perhaps elsewhere. It is reported in Michigan and Ohio. Favored food plants are red pine, jack pine, Swiss mountain pine, mugho pine, with some feeding on white pine and Austrian pine.

The eggs are laid in rows in slits in pine needles and just before hatching look much like pine leaf scales. The tiny young larvae, green with shiny black heads, joining together in gangs, match the needles so well that the gardener almost never sees them until too much damage has been done. They feed at first on sides of old needles, causing a few tip needles to turn straw-colored and curl slightly, an excellent diagnostic sign if you learn to look for it. (Figure 80.) After the first molt, larvae eat entire needles, right down to the base. Several hundred may work together and after demolishing one twig move on to the next. When disturbed, they move in uncanny unison, elevating their rear ends. They confine their feeding to old needles. Infested ornamental pines about the house will show, by the end of May, new green plumes waving at the ends of long naked branches. When the larva is full-grown, after 4 or 5 weeks of feeding, it is grayish-green with a light stripe down the back and 2 white lines bordering a broken stripe of intense green, about 7/8 inch long.

Figure 80

Young larvae of European pine sawfly chewing off needles

Mature larvae drop or crawl to the ground to spin golden-brown cocoons in litter on top of the soil or in protected places on the trunk, sometimes even in the frass left by pine webworms. Pupae are formed in the cocoons in late summer. The adults, emerging to lay their eggs, look something like small bees or large, fuzzy flies. The males are blackish with feathery antennae; the females are yellow-brown.

Control. Spray with lead arsenate with 1 teaspoon nicotine sulfate added per gallon at the first sign of minute worms hatching from the eggs. In most seasons this is the end of April. A delay of a week or two may be too late to keep ornamental pines from being conspicuously defoliated. One *thorough* spraying usually lasts throughout the sawfly season.

Pine plantations have been successfully sprayed with lead arsenate from airplanes, but this is inadvisable near reservoirs, so that parasitic wasps

have been liberated in large numbers in New Jersey. A newspaper item of October 11, 1945, was headed "Jersey's Pal Is M. Fuscipennis," and went on to say that more than five million specimens of *Microplectron fuscipennis* had been liberated in 30 New Jersey townships during 1945 to save thousands of pine trees from devastation.

European Spruce Sawfly (*Diprion hercyniae*)—This European species was first found on the American continent in 1930 at the Gaspé Peninsula, Canada. Since then it has spread at an alarming rate, and by 1937 was ranked as probably the worst enemy of northeastern spruce forests. In Maine it reached its high peak of population in 1939, since when it has declined in numbers due to rodents, insect predators, and parasites. It is now found in all of New England and west to western New York. White spruce is favored in Maine but black spruce, red spruce, Norway spruce, and Colorado blue spruce may all be infested.

Eggs are laid singly on the needles with young larvae starting feeding at the tip. They are light green, with narrow white stripes, and look much like the needles. They pupate in golden-brown cocoons beneath trees. The female adult is stout-bodied, black with yellow markings. Males are very rare and reproduction is usually without fertilization. There are three generations and perhaps a partial fourth in southern Connecticut.

Control. On ornamental trees, lead arsenate gives control. In forest areas most reliance must be placed on insect predators and parasites, birds, and a wilt disease of the larvae. The same parasite liberated for pine sawflies in New Jersey has been extensively used in Maine for spruce sawflies.

Goldenglow Sawfly (*Macrophya simillima*)—Light gray larvae, with a darker gray median stripe and a row of black spots, occasionally defoliate plants. They rest on leaves in a typical coiled position. There is one generation a year, with adults appearing in June.

Control with lead arsenate.

Hemlock Sawfly (*Neodiprion tsugae*)—A western species on hemlock in the Pacific coast range. Larvae are striped when young, later uniform green. They feed chiefly on the foliage and there is one generation a year. A number of parasites keep this sawfly in check.

Honeysuckle Sawfly (*Zarea inflata*)—Climbing and bush honeysuckles may be stripped of leaves by dull-gray, yellow-striped, black-dotted larvae about an inch long. The sawflies are large, with a black abdomen, yellow ring at base, and a line of silver hairs on each segment.

Control. Lead arsenate will protect the foliage.

Imported Currant Worm (*Pteronidea ribesii*)—Arrived from Europe about 1857 and now general over the United States. It is rare to find a garden producing currants or gooseberries without this problem. The sawfly winters in cocoons on the ground with black, yellow-marked adults

appearing in spring to lay white, flattened, shiny eggs on veins and midribs on underside of leaves. The larvae hatch about the time currants are in full leaf (I expect them about Memorial Day in New Jersey). They feed from the margins of leaves, but finally devour entire leaves as they work along a cane in groups. The worms are green with black heads and body spots. When disturbed they elevate front and rear ends of their bodies. After feeding for 2 or 3 weeks they pupate in the ground. Eggs for the second generation, which is not so injurious, are laid in late June and July. (Plate XXXIV, page 335.)

Control. The old remedy of hellebore has been replaced to a large extent by rotenone dust which is effective and safe to use on currants as they are ripening. Pyrethrum sprays or dusts can also be used.

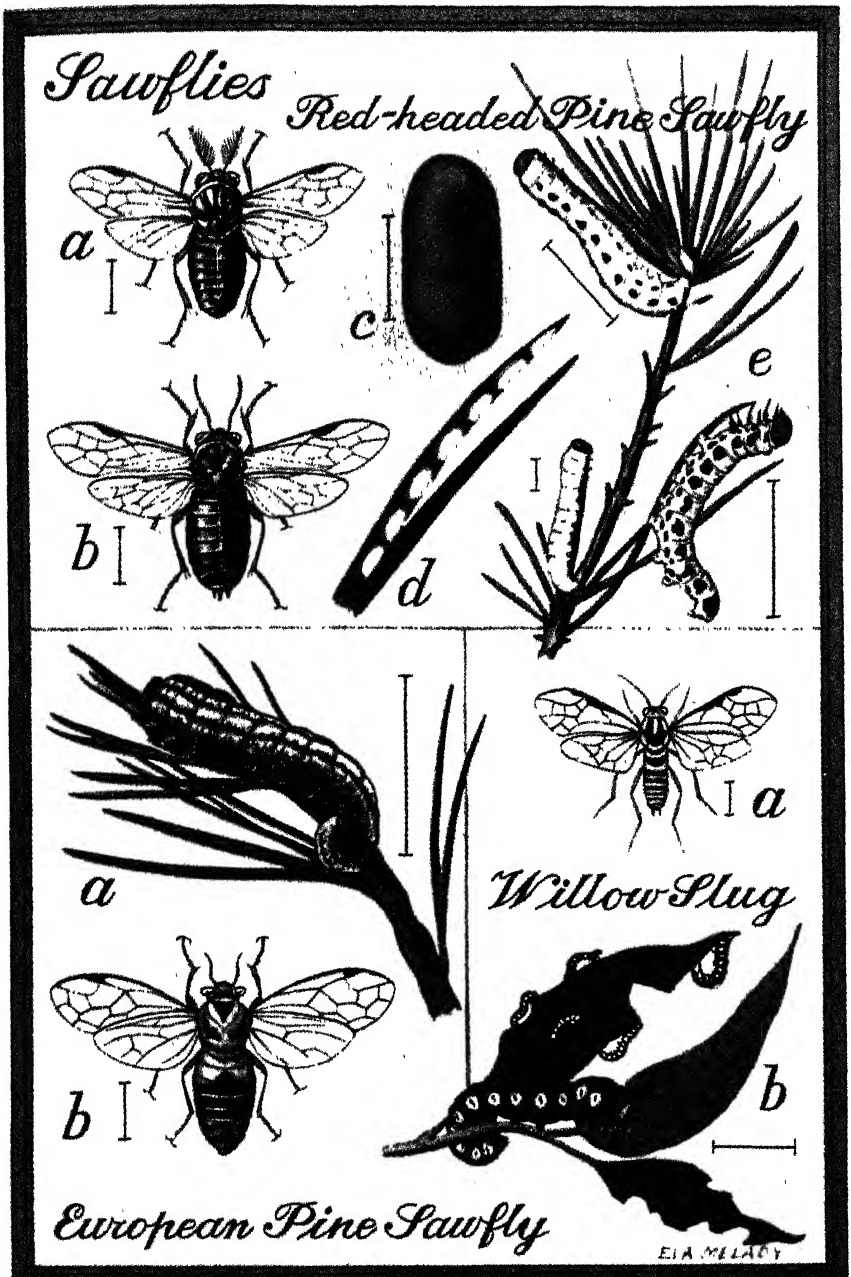
Introduced Pine Sawfly (*Diprion simile*)—First found in Connecticut in 1914. The larvae feed on various pines—white, Japanese, Scotch, mugho, Korean and others. The larvae are greenish-yellow on top, with a double brown stripe the entire length of the back and a broken yellow line on each side; brown sides with irregular yellow spots. The adults are black and yellow, wings spreading 3/4 inch. (Plate XXXIII, page 334.)

The winter is spent as pupae in rubbish on ground, with adults emerging in April and May. They lay eggs in slits cut in edges of needles. There are two generations, with first-brood larvae feeding on older leaves in May and June, the second brood feeding in August and September, with mature new growth as well as older needles chewed off. There may be complete defoliation; small ornamental pines often die.

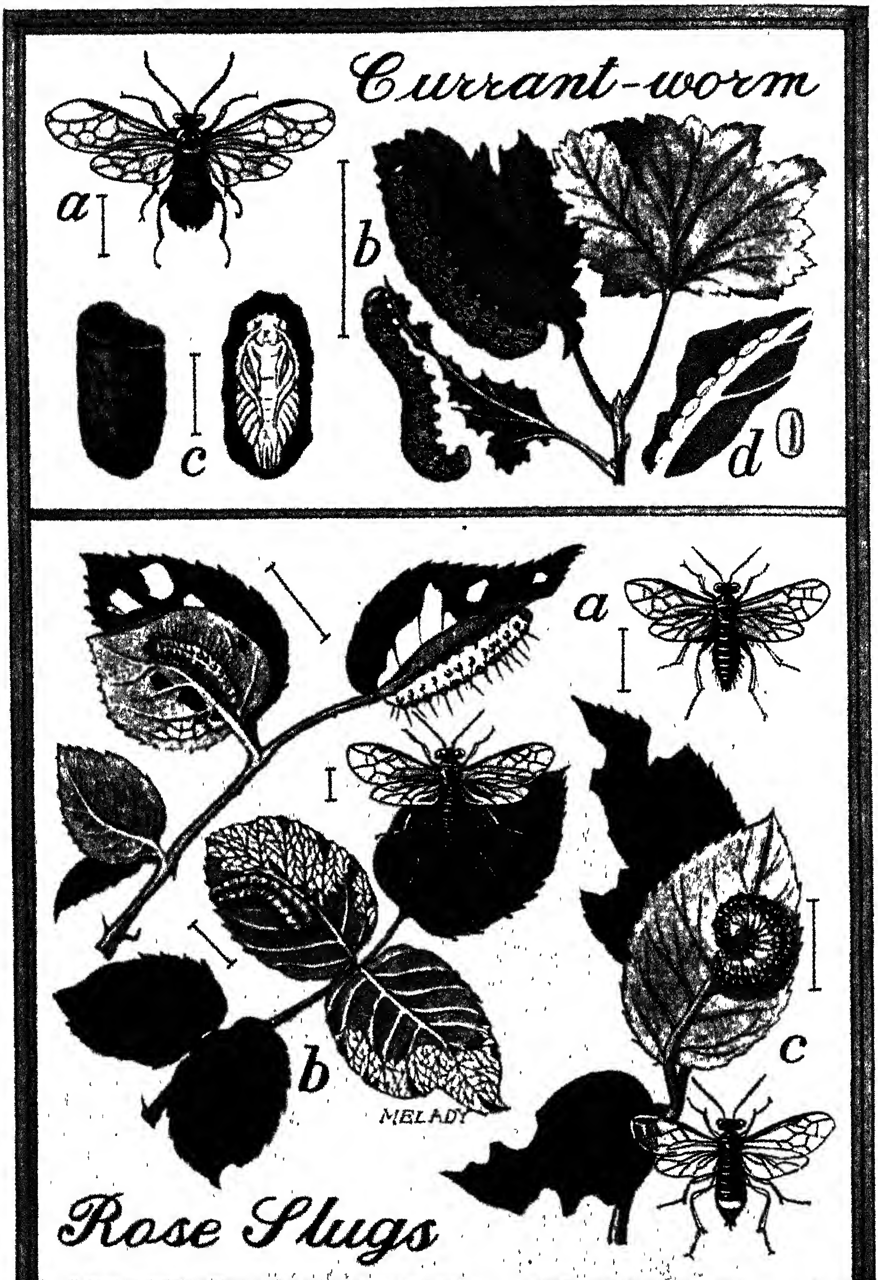
Control. Rake up and burn debris under trees in autumn. Watch for appearance of first-brood larvae and spray with lead arsenate, preferably with a little flour added as a sticker. Nicotine sulfate added at the rate of 1 teaspoon per gallon will kill all young sawflies hit with the spray. Several American parasites breed in this pine sawfly.

Larch Sawfly (*Lygaeonematus erichsonii*)—A European pest first noted in Massachusetts in 1881, now spread as far west as Minnesota. It has repeatedly defoliated extensive areas of larch in the Adirondacks and Canadian forests and is also injurious to ornamental trees in home plantings. It attacks American, European, Japanese, and Siberian larches.

The adults are wasp-like, with shiny black head and thorax, a yellow area in abdomen, wings expanding to 4/5 inch. The young greenish-white larvae change to gray or olive-green with black head and legs, rows of minute tubercles, and small brownish spines. They feed ravenously, in gangs of 40 or 50, on needles which at first turn brown but then are devoured. Lower branches are worked first, later entire trees are defoliated with death following loss of foliage for 3 successive years. Shade trees are not in so much danger as forest trees.



XXXIII **SAWFLIES.** RED-HEADED PINE SAWFLY: **(a)** male adult (much enlarged); **(b)** female sawfly; **(c)** pupa in papery cocoon on ground; **(d)** eggs in slits in needle; **(e)** young and mature larvae feeding on pine. EUROPEAN PINE SAWFLY (See INTRODUCED PINE SAWFLY): **(a)** larva in typical position on pine twig; **(b)** adult (enlarged). WILLOW SLUG (See WILLOW SAWFLY): **(a)** adult; **(b)** young larvae feeding on willow leaves, and mature form.



XXXIV **IMPORTED CURRANT WORM:** **(a)** adult female sawfly; **(b)** larvae and feeding injury; **(c)** cocoon and pupa inside cocoon; **(d)** eggs along vein and single egg (enlarged). **BRISTLY ROSE SLUG:** **(a)** adult sawfly, and slugs (sawfly larvae) feeding on rose leaf. **ROSE SAWFLY or EUROPEAN ROSE SLUG:** **(b)** leaf showing typical skeletonizing (larva and adult somewhat enlarged). **CURLED ROSE SAWFLY:** **(c)** larva shown in typical cutworm position, injured leaf, and adult sawfly.

Wintering is in pupae in soil; eggs are laid in May and June in green terminal shoots which become distorted with twigs dying.

Control. Birds and mice destroy cocoons, parasitic wasps and flies attack larvae, and a fungus works on larvae in cocoons. Rake up debris from under ornamental larches in the fall. Spray with lead arsenate in June or July if necessary.

Loblolly Pine Sawfly (*Neodiprion americanum*)—Known recently in Virginia defoliating loblolly and shortleaf pines; sometimes found on Virginia scrub pine. Eggs winter in needles, hatch in May. Larvae are pale green when young, have black spots and 2 dark longitudinal bands when mature. They work only on old needles and there is but one generation a year.

Mountain-ash Sawfly (*Pristiphora geniculata*)—Dark larvae feed in groups on upper leaves of mountain-ash, leaving nothing but larger veins and midrib. Working shortly before the Japanese beetles appear on the scene in New Jersey, the chewing is usually wrongly attributed to beetles.

Control. One thorough spraying with lead arsenate after the leaves are fully open will control these sawflies. If young larvae are already present when spraying is done, add 1 teaspoon nicotine sulfate per gallon.

Peach Sawfly (*Pamphilius persicus*)—Foliage is sometimes eaten in June and July by pale blue-green larvae, 5/8 inch long. They winter in cocoons in soil, pupate in spring. Adults emerging in late spring are black with yellow markings.

Control. Lead arsenate is the prescribed remedy; rotenone dust is safer for home gardens.

Pear Slug (*Caliroa cerasi*), sometimes called **Cherry Slug**—Distributed throughout the country on cherry, pear, plum, occasionally on hawthorn, Juneberry, mountain-ash, and quince. Larvae are dark green to orange, tadpole-shaped, fleshy, covered with slime, looking as if they might be small slugs. They skeletonize the leaves, eating everything but a network of veins. The black and yellow sawflies, slightly larger than houseflies, emerge from cocoons in the earth just after cherries or pears have come into full leaf, and they lay their eggs on the leaves. Larvae from these eggs feed for 2 or 3 weeks, drop to the ground, and pupate, with adults coming out in July or August to lay eggs for a second brood which may completely defoliate young trees.

Control. These slimy slugs are readily killed by dusts, either nicotine-lime dust or 1 part lead arsenate to 5 of talc, gypsum, or hydrated lime, or with a mild lead-arsenate spray. The best time for cherries is in early spring before fruit is half grown, or after harvest.

Plum Web-spinning Sawfly (*Neurotoma inconspicua*)—A pest in the

Dakotas, for the most part. Grayish-yellow, smooth-bodied false caterpillars, up to ¾ inch long, feed inside silken webs, enclosing leaves at the end of branches of plum and sand cherries, sometimes defoliating trees. Adults have black bodies, reddish legs, lay eggs on leaf midribs.

Control. Many predators and a parasite attack the larvae. Cut off webbed ends of branches; spray with lead arsenate in spring if necessary.

Poplar Sawfly (*Trichiocampus viminalis*)—A European species on Carolina and Lombardy poplars, sometimes on white poplar, aspen, and willows. The larvae are bright yellow with 2 prominent rows of black spots on the back and 2 rows of smaller black spots near the spiracles, tufts of short white hairs over the body, and black heads. They are about ¾ inch long. The young larvae arrange themselves side by side in a row on the leaf and eat ravenously, with trees often entirely defoliated. When grown, in 35 to 40 days, they make cocoons in bark crevices or under clods of earth.

Control with lead arsenate when larvae are very young.

Raspberry Sawfly (*Blennocampa rubi*)—Ranging throughout the northern states but more common along the Pacific coast. Adults are black with yellow and reddish markings; larvae are pale green with white spiny tubercles. They feed on undersides and on edges of leaves, sometimes stripping the plants. Loganberries, dewberries, and blackberries are also infested.

Control. Spray with lead arsenate just before blossoming. Use rotenone dust or spray after fruit is set.

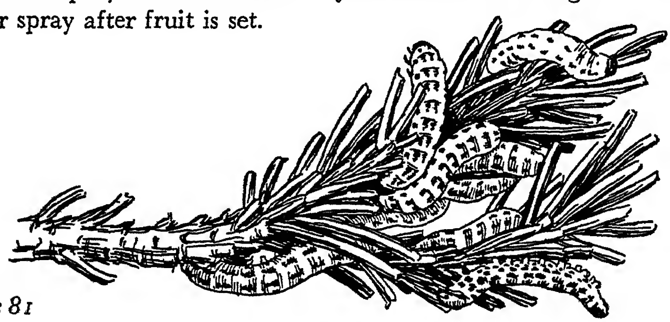


Figure 81

Older larvae of red-headed pine sawfly which have eaten off needles down to the base of the fascicles

Red-headed Pine Sawfly (*Neodiprion lecontei*), often known as **Leconte's Sawfly**—Injurious to ornamental trees over eastern United States from Maine to Florida and west to Louisiana and Wisconsin. At least a dozen species of pines and American larch are attacked. The sawfly female has black abdomen, reddish-brown thorax, slender antennae; the male has a black body with yellow legs, feathery antennae.

The larvae live in groups and devour the needles, often defoliating young pines which die, or are spoiled for ornamental purposes. Young larvae are whitish, later yellow-white with several rows of black spots; they have reddish-orange to brown heads and are an inch long when grown. (Figure 81.) Eggs are laid in slits in needles. There are two overlapping broods, one starting in July and the other in August or September, so that feeding goes on continuously for 3 months. Pupation is in tough papery cocoons in ground or under leaves.

Control. Spray thoroughly with lead arsenate when larvae are young.

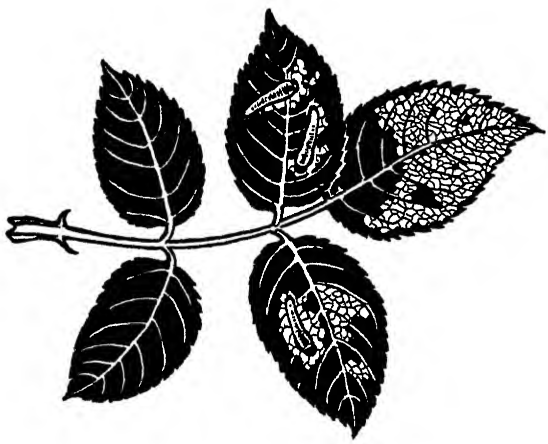


Figure 82

Larvae of the rose sawfly (the European rose slug) skeletonizing leaf

Rose Sawflies. There are 3 common species—the rose sawfly, curled rose sawfly, and the bristly rose slug.

Rose Sawfly (*Caliroa aethiops*), often called **European Rose Slug**—Injurious east of the Rocky Mountains. This is a yellow-green, rather velvety slug, up to ½ inch long. It eats, usually from the upper side, the soft parts of leaves which, with nothing left but a network of veins and one epidermis, turn brown and crisp, making rose growers think they have "rust." When full-grown the larva enters the soil, constructs a capsule-shaped cell, and stays quiet in this cavity until the next spring. The typical fly-like adult lays eggs in pockets in leaf tissue quite near the edge of the leaflet. There is one generation a year. (Plate XXXIV, page 335; Figure 82.)

Control. Rose slugs are easy to kill by spraying or dusting with lead arsenate or other stomach poison, or by using one of the combination sprays such as Tri-Ogen, *provided* you start early enough in the season, when the leaves are first formed. Most people forget to spray until the

damage is done and then have to look at ugly foliage all summer and fall.

Curled Rose Sawfly (*Allantus cinctus*), also called **Coiled Rose Worm**—Eats rose foliage from Minnesota to Maine and south to Virginia. It curls up like a cutworm, starts in by skeletonizing, ends by devouring whole leaflets except for largest veins. When full size the larva bores into pith of pruned rose canes or other soft wood. The adults lay eggs in upper surface of leaflets. There are two generations a year in the southern range of this insect.

Control. Use lead arsenate, or even nicotine sulfate and soap, for young larvae. See also Rose Sawfly.

Bristly Rose Slug (*Cladius isomerus*)—Present east of the Mississippi, north of St. Louis, Missouri, and Richmond, Virginia, and also reported from California. It is said to be the most frequent rose defoliator, and most rosebushes show marks of its presence. Larvae are slug-like, greenish-white with rather long, stout hairs. They first skeletonize leaves by feeding from undersurface, later eat holes clear through. Eggs are laid in slits in upper side of midrib. Pupation for summer generations is in cocoons placed anywhere on leaves or twigs; overwintering cocoons are usually in soil. There may be six broods in a season.

Control. Almost any spray or dust on foliage ahead of chewing will give protection. See Rose Sawfly.

Spruce Sawfly (*Neodiprion abietis*), also known as **Balsam Fir Sawfly**—Works on balsam fir, spruce, and pitch pine in much the same fashion as the red-headed pine sawfly. Larvae are green striped with darker green, and with black heads. They may defoliate trees in midsummer or early fall unless controlled with lead arsenate.

Strawberry Sawfly (*Empria maculata*), or **Strawberry Slug**—Locally destructive east of the Rocky Mountains. Females lay eggs in leaf stems which hatch in 2 weeks into pale green to grayish-yellow larvae, 3/4 inch long when grown. They first eat small round holes in leaves, later consume everything. Winter is spent in cocoons in soil, the small black adult emerging in spring. There is one generation.

Control. Spray with lead arsenate in spring before berries are formed.

Violet Sawfly (*Protemphytus pallipes*)—Often a serious pest of violets and pansies in northern states, outdoors and in greenhouses. Larvae are bluish-black or olive-green smooth caterpillars, about 1/2 inch long, marked with minute white tubercles on back and sides. They work at night, first eating holes in leaves, later chewing in from the margins and almost defoliating plants, most often in May and June. Adults, black and yellow, cause blisters from the eggs laid in tissues of lower side of leaf. Foliage often withers. Pupation is in stalks of pithy plants.

During the day young larvae are often found on underside of leaves curved into a J shape; older larvae lie extended on stems near the ground. There are several broods annually.

Control. Spray or dust with lead arsenate.

White-pine Sawfly (*Neodiprion pinetum*), often called **Abbott's Pine Sawfly**—The larvae are much like those of the red-headed sawfly except that they have black heads. They are yellowish with 4 lengthwise rows of black spots. Feeding habits, life history, and control are about the same as for other sawflies.

Willow Sawfly (*Pteronidea ventralis*), commonly known as **Yellow-spotted Willow Slug**—Widely distributed in eastern United States on willow and poplar. The small, dark brown to black sawfly, marked with yellowish spots, lays eggs in leaf tissue, producing blister-like swellings. The slugs are black with a greenish tinge, with heart-shaped yellow spots along each side of the body. They feed close together in characteristic curved positions for about 3 weeks, then pupate on the ground for a second generation. When this sawfly is abundant, willows are defoliated.

Control. Spray with lead arsenate.

SCALE INSECTS

Scale insects constitute a very large group of plant-feeders. Along with mealybugs, they belong to the family Coccidae, of the order Homoptera. They are sucking insects, with the females alone responsible for plant injury—small, inconspicuous, remaining fixed in one position on the host plants for most of their lives. The males are normally winged as adults; the females are wingless and quite different in appearance, with their bodies covered with secreted materials. This may be a definite hard scaly covering, made of molted skins (exuviae) and special secretions, which stays over the insect but not attached to it. Scales covered in this fashion are called Armored Scales, the group including oystershell, San Jose, scurfy, purple, and many other destructive scales. Armored scales are active for only a short period after hatching; then they lose their legs, stick in their beaks, and stay in that one spot the rest of their lives, forming protective covering after the first nymphal stage.

Unarmored or soft scales include all those which do not live under a special hard covering. In this group are the notorious cottony-cushion scale, tortoise scale, black scale, and many others.

Control depends somewhat on the species, but in general armored scales on fruit trees and shrubs are best taken care of by a dormant spray, oil or lime-sulfur, before new growth starts in the spring, and sometimes a summer contact spray when the young are crawling in spring or summer.

Unarmored scales are more prevalent in greenhouses and in warm climates where there can be no strong dormant spray. For these, white oil sprays of summer strength, often with nicotine added, are advised.

Araucaria Scale (*Eriococcus araucariae*)—Imported into California on Norfolk Island pine. Pure-white, felt-like oval sacs enclose bodies and eggs of females.

Arborvitae Soft Scale (*Lecanium fletcheri*)—Small, brown, hemispherical scale sometimes found on arborvitae. Spray with nicotine sulfate and soap.

Artemisia Scale (*Eriococcus artemisiae*)—Encased in a conspicuous globular white sac, like a mealybug, and crowded on twigs of artemisia.

Aspidistra Scale—See **Fern Scale.**

Azalea Scale—See **Azalea Mealybug.**

Barberry Scale (*Lecaniodiaspis* sp.)—Convex, reddish-brown soft scales numerous at times. Spray with a 1 to 15 dilution of miscible oil when plants are dormant.

Barnacle Scale (*Ceroplastes cirripediformis*)—Found in California, Florida, Louisiana, and Mississippi. The female is reddish-brown covered with white wax shading to gray or light brown. It attacks Australian pine, citrus, bignonia, eupatorium, guava, jasmine, Jerusalem thorn, lignum vitae, myrtle, pear, poinsettia, quince, persimmon, tea.

Beech Scale (*Cryptococcus fagi*)—A European species first present in Nova Scotia, found in Massachusetts in 1929, and now present in most of New England and New York, infesting American and European beech.

In Massachusetts eggs are laid from mid-June to late July with hatching starting about August first and continuing into September, during which period young crawlers are abundant. When the pale yellow nymph settles in a bark crevice it secretes cottony material which spreads out to cover a number of individuals. It becomes adult the next spring and is nearly circular, 1/50 to 1/30 inch across, covered with white wax.

The feeding of the scale insect kills inner tissue of outer bark, but the most important injury comes from a fungus, *Nectria coccinea*, which enters the tree through scale wounds. Foliage and twigs die, bark cracks, wood is infected. Apparently the fungus cannot enter until the scale has fed for a year, nor can it produce the disease without the scale.

Control. The only way to prevent the disease is to control the scale by thorough dormant spraying with a miscible oil.

Black Araucaria Scale (*Chrysomphalus rossi*)—Almost black, much like the Florida red scale. It is a tropical species with a limited distribution on ornamentals in southern California—araucaria, rarely on redwood, but sometimes on abutilon, artemisia, banksia, euonymus, hyssop, oleander, olive, orchids, palm, cycad.

Black Scale (*Saissetia oleae*)—An unarmored species and probably most important from an economic standpoint, causing an annual two-million-dollar loss to fruit growers in California alone. It is present in all citrus-growing regions in the world, but is not so important in the Gulf states as in California. It is a greenhouse pest in the North. Besides citrus—orange, grapefruit, and lemon—important food plants are almond, apple, apricot, avocado, beech, fig, grape, oleander (the most common host in Florida), olive, plum, rose, and English walnut. The injury comes not only from extraction of sap, but from the growth of the black sooty mold fungus (*Meliola camelliae*) which may cover all surfaces of foliage, cutting off light and preventing photosynthesis, coating fruit so it has to be washed and hence is liable to infection from other molds.

Overwintering, partly grown females become adult in spring, almost hemispherical, 1/5 inch across, dark brown to black, with a longitudinal ridge and 2 transverse elevations on the back forming the letter H. They deposit from a few hundred to 4,000 eggs, averaging about 2,000. These are white at first, later orange; they hatch in about 20 days. The young remain under the parent for a while, but start crawling and feeding within 3 days, settling on leaves or new growth but migrating to twigs and branches when partly grown, taking 8 to 10 months to reach maturity. The males are thin, narrow, flat, semi-transparent, and go through a pupal stage into active 2-winged insects, but they are rare, and most reproduction is parthenogenetic. There is usually one generation a year, but sometimes two or a partial second.

Control. Fumigation of citrus trees with hydrocyanic acid, under special fumigation tents at a time when no eggs are present, will control black scale in many sections, but in some parts of California, where the scales have developed a resistance to fumigation, spraying is preferable, using a medium oil at 1½ to 2 per cent dilution. There are several important parasites of the black scale and some beetle predators.

• Volck or other white oil can be used on ornamentals. In addition to the list given above, they include, either in the greenhouse or outdoors in warm climates, aralia, artemisia, mountain-ash, asparagus fern, aster, banana, beech, buckthorn, California mountain holly, California nutmeg, camellia, Deodar cedar, chrysanthemum, citron, croton, eucalyptus, fig, fuchsia, guava, holly, jasmine, Irish juniper, laurel, locust, honey locust, magnolia, maple, myrtle, orchids, palms, pear, phlox, pittosporum, pomegranate, poplar, privet, prune, Japanese quince, rose-of-sharon, rhubarb, rubber plant, sumac, sycamore, tangerine, sago palm, strawberry tree, watermelon, and others.

Black Thread Scale (*Ischnaspis longirostris*)—Sometimes a serious enemy of palms. The female is very narrow, thread-like, 1/16 inch long,

dark brown to black. Its habit of attaching itself parallel to the ribs keeps it from being observed until palms are abundantly infested.

Boisduval's Scale (*Diaspis boisduvalli*)—On palms and orchids. The female is snow-white to light yellow, 1/25 to 2/25 inch across; the male is white, narrow, with 3 ridges on the back.

Cactus Scale (*Diaspis echinocacti*)—A common species in the Southwest and on house cacti. This is an armored scale, the female gray, circular, the male white and slender. Surface of many cacti may be completely encrusted.

Control. Oil sprays sometimes injure cacti. Brush off the insects with a stiff brush or scrape off with a piece of wood. A weak pyrethrum spray may be safe.

Calico Scale (*Lecanium cerasorum*)—Found in California. The female is hemispherical, shiny, marked with yellowish areas on a brown background, found in winter on lower surfaces of larger branches, the young moving to smaller twigs and branches in spring. It infests cherry, elm, maple, pear, prune, Boston ivy, Virginia creeper, English walnut, but is not often numerous enough to call for control measures.

California Red Scale (*Aonidiella aurantii*)—More important in semi-arid California than in the humid Gulf states. This scale is thought to have arrived in southern California prior to 1875 on citrus nursery stock from Australia. It now occurs in greenhouses in many parts of the country, but is known outdoors only in the South. Although primarily a pest of citrus—citron, grapefruit, lemon, orange, tangerine—it also infests acacia, aloe, apple, aspidistra, avocado, breadfruit, banana, boxelder, boxwood, chinaberry, coconut, eucalyptus, euonymus, fig, fuchsia, grape, hibiscus, holly, Japanese yew, jasmine, mango, mulberry, oak, olive, palms, passion vine, pistachio, privet, quince, rose, sago palm, sweet bay, tea, English walnut, willow, yucca. The scales attack all parts of trees or shrubs—leaves, twigs, or fruit. Leaves and fruit are spotted with yellow, foliage turns entirely yellow.

The mature female is pinhead size, 1/12 inch across, armored, reddish-brown, circular. Young scales are born alive, like many aphids. They stay under the parent scale for a few hours, crawl about for a day or two, then settle down and insert their sucking beaks at the places where they will spend the rest of their lives. Cottony secretions are molded into a cap-like covering with a small nipple-like prominence in the center. After the first molt, in 10 to 15 days, the cast skins or exuviae are incorporated into the center of this cap, which is enlarged at the side. After the second molt and second enlargement of the scale there is a gray margin extending beyond the body. During this period the scale is called the gray adult and is fertilized by the small yellow-winged male. In 40 to 65

days after the crawling stage the female starts producing living young, and continues to give birth to 2 or 3 scales a day for about 2 months. There may be four generations a year.

Control. Usual methods are cyanide fumigation of citrus trees, under tents, or oil sprays, or both, since the scale has developed forms which are quite resistant to cyanide fumigation. Derris added to oil sprays gives increased control. DDT is promising. There are a number of parasites, some of which are produced in mass quantities for liberation.

Camellia Scale (*Lepidosaphes camelliae*)—Not so important as the tea scale on camellia but often damaging young plants. The female shell is light to dark brown, oyster-shaped, covering a white to purplish sac-like body. The male shell is smaller and narrower. The female starts laying eggs 40 to 50 days after birth, with the life cycle completed in 60 to 70 days. Foliage is devitalized, drops prematurely but is not discolored. Few crawlers are present from October to March outdoors, but hatching continues in greenhouses.

Control. Apply oil sprays as for Tea Scale. A parasitic wasp and lady-beetles are helpful.

Camphor Scale (*Pseudaonidia duplex*)—First noted in this country in New Orleans in 1920, now present in Alabama, Mississippi, Louisiana, and Texas. This scale, circular, moderately convex, dark blackish-brown, with orange exuviae, is about 1/10 inch long. It feeds on nearly 200 plants, with preference for the camphor tree, Japanese persimmon, sweet olive, camellia, satsuma orange and other citrus, Japanese honeysuckle, fig, confederate jasmine, glossy privet, rose; and is sometimes injurious to avocado, elm, grape, hackberry, and pecan.

The camphor scale is so injurious that just a few scales on a twig may cause defoliation. It can kill a tree within 6 months of attack. Ants are believed to help disseminate the insects.

Control. Spraying with a 2 per cent oil emulsion is said to give control.

Chaff Scale (*Parlatoria pergandii*)—A greenhouse pest, infesting some outdoor plants in California but more in Florida. Food plants include asparagus fern, araucaria, camellia, citrus, croton, camphor, cinnamon, cycad, euonymus, guava, jasmine, mango, magnolia, maple, orchids, palms, sweet olive, wandering Jew. The female is circular to elongate, smooth, semi-transparent, brownish-gray with marginal yellow exuviae.

Citricola Scale (*Coccus pseudomagnoliarum*)—A serious citrus pest in parts of California; found also on hackberry, pomegranate, English walnut, and elm. It resembles soft brown scale but is grayer, lays eggs instead of producing living young, has only one generation, and is present over entire tree rather than confined to single twigs.

Cottony-cushion Scale (*Icerya purchasi*), or **Fluted Scale**—An Aus-

tralian native introduced in California on acacia about 1868. It quickly spread to ornamental plantings and citrus orchards in southern California, increasing so rapidly that inside 20 years it threatened the complete destruction of the citrus industry. The story of the search for a natural enemy and its introduction is told under vedalia, the Australian ladybeetle. It was the first successful control of a pest by introduction of a natural enemy.

Figure 83

Cottony-cushion scale—females with fluted egg masses, and winged male

The cottony-cushion scale is now present in southern states on a long list of host plants and in greenhouses. Food plants include acacia, almond, amaranthus, apple, apricot, boxwood, buckeye, California sage, castor bean, casuarina, cedar of Lebanon, chrysanthemum, citron, cypress, fig, geranium, grape, grapefruit, sweet gum, Guadalupe palm, hackberry, ironwood, Boston ivy, laurel, lemon, lime, locust, magnolia, maple, mistletoe, holly oak, laurel oak, white oak, orange, peach, pear, pecan, pepper, pine, pittosporum, poinsettia, pomegranate, potato, quince, rose, sunflower, verbena, veronica, English walnut, and willow. Trees may be completely covered with the white scales and sooty mold growing in their honeydew. (Figure 83.)

The insect itself is reddish-brown, but after egg-laying the female has attached to itself a large, compact, white, fluted cottony mass, holding from 600 to 800 bright red eggs. This white egg mass sticks out at an angle from the twig and is very conspicuous. Hatching of eggs in the fluted ovisac occurs in a few days in summer, up to 2 months in winter. Young larvae are red with black legs, dark antennae, long hairs at the end of the body. Even after molting the scale keeps its legs and can move about until the egg sac is formed. The males are very tiny, with long white filaments.

Control. Vedalia, the Australian ladybeetle, is now so well established that it keeps cottony-cushion scale from obtaining economic importance

on citrus. Colonies of vedalia can be obtained from state insectaries. One or two parasites and a fungus are also helpful. When this scale is abundant in greenhouses or on ornamentals outdoors, and vedalia is not present, spray with oil as recommended for mealybugs and other scales on growing plants.

Cottony Bamboo Scale (*Antonia crawi*)—On bamboo in greenhouses, outdoors in warm climates. Oval, dark reddish-purple bodies are enclosed in thick white cottony sacs, often crowded at leaf axils. They may be quite injurious.

Control. Spray greenhouse bamboo with Volck at a 1 to 50 dilution, hosing off well with water the next day.

Cottony Maple Scale (*Pulvinaria vitis*)—A native species distributed throughout the country, most destructive in the North. It prefers silver maple but also infests Norway and sugar maples, boxelder, alder, apple, beech, blackberry, boxwood, buckeye, currant, dogwood, elm, euonymus, grape, gooseberry, hackberry, hawthorn, lilac, linden, locust, honey locust, mountain-ash, mulberry, oak, osage orange, peach, pear, plum, poplar, quince, rose, spirea, sumac, sycamore, viburnum, Virginia creeper, willow.

This is a spectacular scale covering trees with cottony masses on underside of twigs and branches, which may die, with foliage of the whole tree turning a sickly yellow. (Plate XXXVI, page 367.)

The insect winters as a small, brown, flattened female, 1/8 inch long, attached to bark. When sap flows in spring it starts growing rapidly, depositing eggs in a cottony mass of wax several times the size of the original scale, and contains 1,500 to 3,000 eggs. Around New York the young hatch during June, crawling from twigs to leaves, where they suck sap along midrib and veins. They mature in August and September and mate; the males die and the females crawl back to the twigs for winter. There is only one generation.

Control. Apply the usual dormant oil spray in spring, before growth starts, except on maples, which are often injured by some oil sprays. Dr. Glenn W. Herrick suggests 1 gallon of light summer oil (Volck) plus 1/2 pint nicotine sulfate, 4 pounds powdered soap to 50 gallons of water as a relatively safe spray for maples.

There are many natural enemies, including ladybeetles, the caterpillar of a moth, and a chalcid wasp.

Cyanophyllum Scale (*Aspidiotus cyanophylli*)—On orchids, rubber plants, and other greenhouse plants. The scale is translucent, covered with a waxy secretion, becoming white and opaque after death.

Cypress Bark Scale (*Ehrhornia cupressi*), or **Cottony Cypress Scale**—Common on Monterey cypress, also attacking Guadalupe and Arizona cypress and incense cedar in California. Limbs will turn yellow, then red

or brown, making trees look scraggy. Spotted trees in cypress hedges may die. The scale has a pink body covered with loose white wax; it is usually found in pits or cracks in bark.

Control. Spray with a miscible-oil emulsion in August and again in late September.

Date Palm Scale (*Parlatoria blanchardii*)—Introduced from Egypt in 1890. This small gray and white scale, often appearing in great numbers on leaves of date palm, was supposedly eradicated from California in 1934. Any reinfestation should be reported. When the young date industries of California and Arizona were seriously menaced by this scale an eradication campaign was inaugurated in 1922, with some infested trees destroyed, others pruned and torched—that is, cut back to the trunk and then seared with a gasoline torch, which quickly killed the scale while the palms recovered. The campaign was markedly successful—a real achievement in applied entomology.

Dictyospermum Scale (*Chrysomphalus dictyospermi*), **Spanish Red Scale**—Widely distributed in subtropics, first reported in California in 1909 in greenhouses and lathhouses where it still occurs on Kentia palms and sometimes on orchids. There have been a few infestations outdoors on avocado and lemons in California and it is an important pest of avocado in Florida.

The female is circular, dark orange-brown, secreting much honeydew. It deposits eggs but otherwise is much like the California red scale and infests a similar list of host plants in addition to those mentioned here. There are three or four generations a year in California, five or six in Florida.

Control. Syringe palms forcibly and repeatedly, control ants, which carry young scales around, spray with strong nicotine-sulfate-and-soap solution alternating with Volck, if necessary.

Dogwood Scurfy Scale (*Chionaspis corni*)—Occasionally so abundant on pagoda, silky, and red-osier dogwood that it turns the stems white. This is a northern species present from Massachusetts to Indiana and Kansas. It looks much like scurfy scale on apple.

Control. A dormant lime-sulfur spray is effective. The scales are heavily parasitized.

Elm Scurfy Scale (*Chionaspis americana*)—Distributed from Massachusetts to Minnesota, Kansas, and Texas, usually more serious in the Middle West than in the East. Found most often on American elm, it may attack Camperdown and other elm varieties, killing branches or sometimes young trees outright. The female is pear-shaped, convex, rather thick, 1/12 to 1/8 inch long, naturally white but grayish from bark fragments. It is found only on bark. The male is white, very small and narrow,

found on both bark and leaves. Purple eggs winter under the female shell. There are probably two generations.

Control. Spray with a miscible oil with nicotine added, in early spring, close to hatching time of eggs. A ladybeetle and some parasites feed on this scale.

Euonymus Scale (*Chionaspis euonymi*)—Doubtless known to everyone growing euonymus; also common on bittersweet and pachysandra, sometimes on lilac and orange. It is said to be more abundant and injurious in warmer parts of the country, but limited personal observations make me believe it is less of a pest in California and the deep South than from Massachusetts down through the mid-South.

The female scales look like dark brown oystershells and are 1/16 inch long; the males are almost needle thin, very white. (Plate XXXV, page 366.) Stems and leaves are often almost entirely covered with the white males, with scattered brown females; leaves turn yellow, may drop, vines die back. Climbing euonymus covering walls is most often infested. Eggs winter under the female shells and hatch in late spring. Pale yellow crawlers are visible in late May and June, and there is often a second generation in late summer.

Control. Spray very thoroughly with a miscible oil, 1 to 15 dilution, plus nicotine or Elgetol, just before growth starts at the end of March or early April (in New Jersey). It is difficult to cover parts against buildings well, so if the early spray is not thorough, spray euonymus and bittersweet again in June, for crawlers. Nicotine sulfate and soap will help, but for a better job use Volck, diluted 1 to 50, plus 1 teaspoon nicotine per gallon. Do not spray if the temperature is above 85° F. If a vine is too much encrusted with scale cut it back almost to the ground, burn the trimmings, and try to keep the subsequent growth clean. The scale is often bad on pachysandra that is too crowded. Pull out and burn infested plants; spray the rest with nicotine sulfate or summer oil.

European Elm Scale (*Gossyparia spuria*)—First found at Rye, New York, in 1884, now spread across the country wherever American, European, slippery, cork, and other elms are found. This is one of the soft or unarmored scales. The female is oval, greenish-brown with a white waxy fringe around the entire body, which is 1/10 inch long. Males are very small, winged or wingless. Infested trees have yellowed foliage, usually shed prematurely, small branches die, then larger branches, sometimes a whole young tree. Honeydew may be so copious that it drops to sidewalks or on cars parked underneath, and keeps the branches sooty black from the mold growing in it.

Control. Scales can be washed from trees with the hose, under high

pressure, early in spring before leaves come out. A dormant miscible oil is satisfactory. There are not many parasites or other natural enemies.

European Fruit Lecanium (*Lecanium corni*), or **Brown Apricot Scale**—Distributed throughout the states; quite injurious on the Pacific coast. The scale has various forms and may represent more than 1 species. Typically the female is large, ⅛ to 1/16 inch, hemispherical, smooth, shiny brown, sometimes covered with a powdery material. The male is smaller, flatter, elongated, almost transparent, with ridges. In California it winters as a half-grown scale, lays eggs in great abundance under the shell in April and May with hatching from May to July. The females may be so numerous that they overlap on small twigs. (Figure 84.)

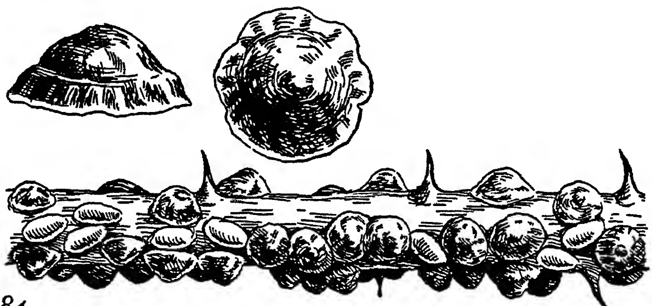


Figure 84

European fruit lecanium on blackberry cane

Apricot, prune, and pear, and arborvitae in cooler climates, are favored hosts. Other plants sometimes infested are alder, apple, ash, basswood, beech, blackberry, boxelder, cherry, chestnut, Catalina cherry, currant, elm, gooseberry, greasewood, grape, hawthorn, hazelnut, California Christmasberry, locust, magnolia, osage orange, peach, pecan, persimmon, plum, poplar, quince, rose, and willow.

Control. The fruit lecanium is heavily parasitized, infected individuals turning black. Spray trees when dormant (December to February in California) with miscible-oil emulsion.

Fern Scale (*Pinnaspis aspidistrae*)—A greenhouse or house-plant pest. The males are white and conspicuous, the females oyster-shaped and ochre-brown, often in sufficient numbers to make ferns very unsightly. Besides aspidistra and ferns this scale also infests acacia, banana, fig, mango, orange, orchids, palms, pepper tree, and other plants. (Figure 85.)

Control. Spray with Lemon Oil, or perhaps a white oil used with great care. Small potted ferns can be dipped in a solution of a contact insecticide.

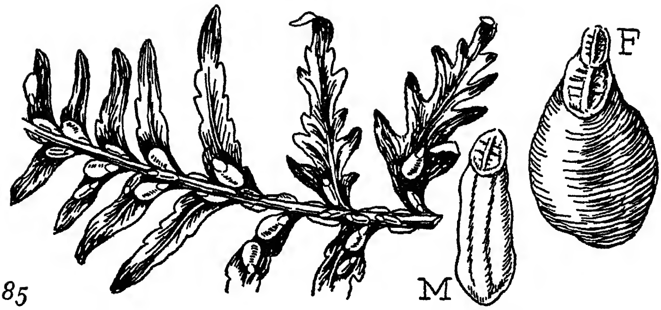


Figure 85

Fern scale, with detail of pear-shaped female, thin male

Fig Scale (*Lepidosaphes ficus*)—On figs in some parts of California. It attacks leaves, fruit, wood up to 2 years old, is similar to the purple scale but smaller, and is controlled with oil sprays in spring when the buds expand.

Florida Red Scale (*Chrysomphalus aonidum*)—An important citrus pest in Florida and other Gulf states, occurring on some nursery plants in California but not on citrus to any extent. In greenhouses, favored food plants are citrus, aspidistra, and palms, but the scale also infests aralia, araucaria, banana, begonia, camellia, camphor, coconut, eucalyptus, eugenia, fig, grape, guava, iris, English ivy, jasmine, mango, oleander, orchids, rubber plant, rose, sago palm, zamia.

The Florida red scale resembles California red scale but it attacks only leaves and fruit, not twigs, deposits eggs instead of having living young, and does not injure with copious honeydew.

The female is circular, reddish-brown to nearly black, with a lighter central portion. In greenhouses it breeds throughout the year with five or more generations. (Figure 86.)

Control. Oil emulsions are recommended for citrus. Follow your state

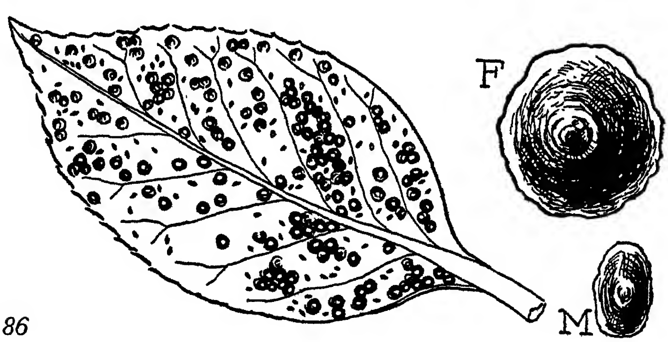


Figure 86

Florida red scale on underside of leaf, with detail of male and female

experiment station recommendations for concentration and timing. A fungus is helpful in control. Use white oils or other contact sprays for greenhouse plants.

Florida Wax Scale (*Ceroplastes floridensis*)—Found in Florida, Louisiana, Mississippi on fruits and ornamentals. The reddish or purple-brown body is covered with a thick, white, waxy coating tinted with pink, often with some dark spots. Red eggs are laid under the body of the scale which shrinks as they accumulate. Crawlers collect on underside of leaves along midribs; adults cling to twigs. There are about three generations in Florida.

Host plants include apple, avocado, andromeda, custard apple, anthurium, bay, blueberry, boxwood, cape jasmine, cherry, laurel, cinnamon, citrus, croton, cryptostegia, euonymus, fern, ficus, guava, lignum vitae, ilex, India hawthorn, ixora, loquat, mango, magnolia, maple, mulberry, crape-myrtle, oleander, peach, pomegranate, pear, pine, pittosporum, plum, poinsettia, prickly ash, sapodilla, sea grape, tea.

Control. Spray with oil emulsion, 1 to 2 per cent, according to host tolerance, usually not over 1¼ per cent for easily injured plants.

Forbes Scale (*Aspidiotus forbesi*)—Present throughout the United States east of the Rocky Mountains on cherry, apple, apricot, pear, plum, quince, currant. It may be especially abundant on sour cherries. Scales are grayish, thin, flaky masses, with a tiny raised reddish area in the center, on bark and branches. Partly grown scales winter on bark, young appear in May, born alive and from eggs. There may be one to three generations a season.

Control. Use dormant oil or lime-sulfur sprays as for San Jose scale.

Gloomy Scale (*Chrysomphalus tenebricosus*)—Often abundant on soft and red maples in southern states. It is dark gray, circular, very convex, melting into the bark in color. Spray with lime-sulfur 1 to 8 when trees are dormant.

Glover Scale (*Lepidosaphes gloverii*)—Found in southern states, often associated with purple scale and with a similar life history. It is more important in Florida than in California. Food plants include cabbage palmetto, cherry, coconut, croton, laurel, mango, magnolia, palms. The female is long, narrow, straight, or curved, brownish-yellow to dark brown.

Grape Scale (*Aspidiotus uvae*)—Generally distributed on grape, sometimes on peach, hickory, sycamore. It resembles San Jose scale in size and habits. The shells are circular or elliptical, gray or yellow-brown with a pale yellow spot and white nipple at one side of center. Scales are usually present on old canes under loose bark. There is one generation a year.

Control. Severe pruning may be sufficient; if not, give a dormant spray of oil or lime-sulfur

Gray Citrus or **Citricola Scale** (*Coccus pseudomagnoliarum*)—Resembles soft scale but is larger and mottled gray. Scales may overlap to form complete crust over citrus twigs and produce so much honeydew that foliage and fruit are badly smutted with sooty mold. It may be abundant on daphne as well as citrus.

Greedy Scale (*Aspidiotus camelliae*)—One of the most common armored scales, attacking ornamentals throughout North America, mostly in greenhouses, outdoors in warmer climates. The small scales are very convex, light gray, thin, pointed, with yellow or dark brown exuviae near one edge. They are omnivorous feeders on bark, sometimes on leaves and fruit, of acacia, almond, apple, avocado, bay, birch, cactus, camphor, chinaberry, camellia, ceanothus, cherry, cissus, cotoneaster, cottonwood, English holly, English ivy, English laurel, eucalyptus, euonymus, fig, fuchsia, genista, guava, sequoia, grape, heath, mountain holly, honeysuckle, Japanese quince, California laurel, lavatera, locust, magnolia, maple, manzanita, mistletoe, myrtle, mulberry, olive, orange, Oregon grape, oak, palms, passion vine, pear, pecan, pepper tree, pittosporum, pomegranate, pyracantha, quince, redbud, rose, sage, sedum, strawberry tree, silver tree, strelitzia, silk oak, umbrella tree, English walnut, willow.

Control. Fumigate with calcium cyanide in greenhouses or spray with summer white oils where they are safe for various hosts.

Green Shield Scale (*Pulvinaria psidii*)—On ornamentals in Florida. A white cottony egg sac projects from a green shield. Food plants include avocado, Australian oak, bay, citrus, clerodendron, croton, cycad, cypress vine, fern, ficus, guava, gardenia, hibiscus, ixora, jasmine, apple, mango, palm, persimmon, rose, sapodilla, sea grape, tea, wax myrtle, yellow elder.

Hemispherical Scale (*Saissetia hemisphaerica*)—A tropical species common in greenhouses and in the open in various parts of California

Figure 87

Hemispherical scale on fern—note detail showing cushion shape and height

and other warm climates. It is common, though not of great importance, on citrus and avocado, is quite conspicuous on ferns, palms, and other ornamentals, including aloe, asparagus fern, banana, bignonia, camellia, chrysanthemum, citron, croton, cycad, custard apple, apple, grapefruit, guava, lemon, oleander, orange, orchids, sago palm, sourberry, sumac, pepper tree, and zamia. The female is a smooth glossy brown, hemispherical with flared margins, about 1/8 inch in diameter. (Figure 87.)

Control. Use a summer oil, such as Volck, with nicotine, syringing off greenhouse plants a few hours later.

Hemlock Scale (*Aspidiotus ithacae*)—A native American species, widely distributed, quite common in the West. Scales are circular, nearly black, occur in great numbers on underside of needles of hemlock, Douglas fir, Monterey, yellow, knob-cone, and other pines. They sometimes kill young trees.

Howard Scale (*Aspidiotus howardi*)—A Rocky Mountain species occurring chiefly at high altitudes in Colorado and New Mexico. The female is circular, flat, pale gray with a reddish tinge, and when it infests fruits causes pitting and a reddish stain. Pear is the preferred host but it also infests other deciduous fruits and ornamentals, including almond, apple, ash, peach, plum, prune.

Control measures are the same as for San Jose scale.

Italian Pear Scale (*Epidiaspis piricola*)—An orchard pest of pear, peach, plum, prune, apple, and Persian walnut and a very special pest of that lovely ornamental known as mountain holly or California Christmasberry. The female is dark red or purplish, covered with a circular, dark gray, and shiny shell with dark brown exuviae. The male is slender, white with yellow exuviae. Infestations of long duration cause deep depressions in limbs and may hasten death. Lichens usually cover the scales. Many mountain holly shrubs are killed or disfigured.

Control. Spray in winter (January in California) with a heavy oil emulsion, drenching limbs and trunks, adding 1 ounce caustic soda to each 2 gallons of spray to remove the lichens protecting the scales.

Ivy Scale—See **Oleander Scale.**

Japanese Scale (*Leucaspis japonica*)—A pest of privet, soft and Norway maples, well established in Connecticut and New York. It looks like a narrow oystershell scale, 1/16 to 1/12 inch long, dull grayish-white, and often thickly infesting trunk or branches.

Control. A dormant miscible-oil spray is satisfactory.

Juniper Scale (*Diaspis carueli*)—A European species distributed throughout the United States on several juniper species, on arborvitae, incense cedar, and cypress. It is an exceedingly common pest of junipers used in foundation plantings about houses. Whenever the shrubs look

dingy gray, or yellowish and generally unthrifty, examine the needles closely for very small, dirty-white round scales. (Plate XXXV, page 366.) The male is white and even smaller, 1/25 inch long. Nearly grown females winter on the needles; young yellowish crawlers appear early in June.

Control. A dormant miscible-oil spray at the 1 to 25 dilution for evergreens is sometimes recommended for this scale, except on those junipers whose needles form a cup to hold the oil and are subject to injury from it. But I have had much better luck with lime-sulfur, at a 1 to 9 dilution, applied in early April before growth starts. Since lime-sulfur blackens paint it cannot be used near painted buildings unless a canvas is held between the shrub to be sprayed and the painted surface. Nicotine sulfate and soap can be applied in summer for the crawlers.

Latania Scale (*Aspidiotus lataniae*)—Widely distributed in greenhouses on palms, orchids, and other ornamentals, an outdoor pest of ornamentals in Florida and of avocado in California. It was named in 1869 from a palm, *Latania,* in a French conservatory. The number of world host species is 163, but in California outdoors it is limited mostly to avocado, cannas, gladiolus, raspberries, roses, and tamarix. It looks much like greedy or oleander scales, small, circular, strongly convex, gray with pale brown exuviae. It lays yellow eggs and crawlers are sulfur-yellow.

Control. Several ladybeetles are predators and a chalcid wasp is a parasite. Avocado is fumigated with cyanide under a tent, or sprayed with 1½ to 2 per cent oil emulsion. Spray greenhouse plants as for other scales.

Lecanium Scale (*Lecanium coryli*)—A European scale often called tree lecanium because it attacks a wide variety of plants, but not herbaceous ones. It is present along the Pacific coast on maples, horsechestnut, hawthorn, cherry, beech, lime, apple, pear, plum, alder, and sometimes birch, poplar, willow, and elm. The female is hemispherical, mottled brown, rather large. Young insects crawl to the leaves in summer; return to twigs in fall.

Control. Spray maples with nicotine sulfate and soap during the crawler stage; other trees with a dormant-oil spray in early spring.

Lesser Snow Scale (*Pinnaspis minor*)—A general pest of ornamentals in Florida. The pest is pear or oyster-shaped, white, semi-transparent, sometimes speckled with brown from incorporation of bark fragments. The male is white, elongate. Food plants include avocado, abutilon, asparagus fern, albizzia, Australian silk oak, bignonia, boxwood, bryophyllum, cactus, caladium, camphor, cassava, cassia, castor bean, century plant, chinaberry, citrus, croton, cycad, ficus, grape, hackberry, hibiscus, hollyhock, mango, mesembryanthemum, morning glory, mountain ebony,

oleander, palm, paradise vine, parkinsonia, pepper tree, pelargonium, pittosporum, royal poinciana, sapodilla, spider lily, sumac, sweet potato, thunbergia, wisteria, woodbine.

Control with summer oil sprays (Volck or other white oils).

Magnolia Scale (*Neolecanium cornuparvum*)—A soft scale, probably a native, distributed over eastern United States on various species of magnolia. The female is large, ½ inch across, notably convex, covered with much white wax under which the body is shining brown with honeycomb pits and large glands. When the scales are numerous the branches look as though covered with white cotton, and when the scales are removed a scar is left on the bark. Trees may be severely injured, look sickly; leaves remain small. There is also much honeydew to encourage sooty mold over leaves and branches.

Young nymphs hibernate on newer wood, molt early in the spring and again in June to a dark slate color, and then start secreting white wax. By August they are producing living young. There is one generation in the North.

Control. A dormant oil spray gives excellent results. In summer the large scales can be rubbed off with a stiff brush.

Maple Phenacoccus (*Phenacoccus acericola*), or **Woolly Maple Scale**—Distributed over northeastern states to Minnesota and south to Maryland, mostly confined to sugar and silver maples but recorded on hornbeam, limetree (basswood), and horsechestnut. Undersurface of leaves appears coated with white wool. Partly grown nymphs winter in bark crevices in trunk and branches, then migrate to twigs and young leaves in spring. The males return to the trunk in late spring to pupate in white cocoons, the females come there to mate and then return to leaves to lay eggs which hatch in July. There is one generation.

Control. There are several efficient insect enemies. It is safer not to spray maples with oil but to use nicotine sulfate and soap while nymphs are on trunk and branches.

Mediterranean Fig Scale (*Lepidosaphes ficus*)—On figs in California. The scale looks like purple or oystershell scale but is smaller. It normally attacks fruit and wood less than 2 years old.

Mining Scale (*Howardia biclavis*)—This is a circular, moderately convex, white, or grayish scale that mines partly into bark and in epidermis of leaves and twigs. It occurs on hibiscus and Australian pine and oak, begonia, casuarina, citrus, jasmine, ficus, fig, poinsettia, pomegranate, privet, wisteria, to name a small selection of ornamental host plants.

Oak Gall Scale, or **Kermes** (*Kermes pubescens*)—Distributed widely on oak in northern United States. The female is globular, mottled light brown, ⅛ inch across, looks more like a hard gall than a scale. It is present

along veins and on terminal twigs. Leaves are distorted and puckered; growth checked. Winter is spent on bark, but in spring females migrate to leaves with young, first covered with a white pubescence, sucking on the leaves.

Control with a miscible-oil spray in early spring.

Obscure Scale (*Chrysomphalus obscurus*)—On pecan, hickory, and oak, found from Massachusetts west to Arkansas, south to Florida. It is a very special pest of pecans from Alabama to Texas, may also occur on chestnut, chinquapin, dogwood, grape, plum, maple, willow, wild myrtle. The female is roughly circular, grayish, closely resembling tree bark. The male is half her size. On pecans the infestation starts on lower and inner tree parts and gradually spreads up and out, killing many smaller branches, reducing vigor, making the tree more susceptible to attacks of other insects. There is one generation a year with crawlers moving in June, developing their scales until January.

Control. Lime-sulfur as used for San Jose scale is effective. Oil emulsions or miscible oils at dormant strength give better results but are safe only if applied during the strictly dormant period—January and February in the Gulf states.

Oleander Scale (*Aspidiotus hederae*), often called **Ivy Scale**—Present through warmer states and in houses and greenhouses in the North. The scale is circular, flat, pale yellow, about 1/10 inch across. As the name implies it is especially serious on English ivy and oleander, but it is an omnivorous feeder with a very long list of host plants, including century plant, cycads, and palms in greenhouses and olives, lemons, oranges outdoors in California. A few other hosts are acacia, aloe, avocado, azalea, cactus, camellia, ferns, genista, magnolia, orchids, pepper tree, poinsettia, redbud, rubber tree, yucca.

Control. Spray frequently with nicotine sulfate and soap when young are crawling, or use summer oil emulsions with due care.

Olive Parlatoria (*Parlatoria oleae*)—An introduced pest established at three widely scattered points, near Baltimore, Maryland, on privet, in California, and in Arizona. The female shell is dirty-gray, ovate-circular, very small; the insect under the shell is purplish-brown. For many years this insect stayed on a few plants on the university campus at Tucson; then, after a series of mild winters, became epidemic on many new hosts, affecting twigs, leaves, fruit of almond, apple, apricot, ash, Brazilian pepper, grapefruit, sour orange; cotoneaster, elaeagnus, grape, English ivy, jasmine, Kentucky coffee tree, loquat, Chinese lilac, mulberry, oleander, olive, palms, peach, pear, periwinkle, photinia, plum, pomegranate, privet (California, Chinese, glossy, and Japanese), pyracantha, rose, sage, trumpet vine, tung oil tree, viburnum, Virginia creeper.

Control. Spray with oil emulsion.

Oystershell Scale (*Lepidosaphes ulmi*)—Generally distributed throughout the United States on deciduous trees and shrubs, probably known to every home gardener and fruit grower. As the name implies, the scales look like miniature oysters encrusted over trunks, limbs, twigs, or on soft stems. The females are light to dark brown, shiny, with many parallel cross ridges. (Plate XXXVI, page 367.) You can almost always see these scales on trunks or branches of old lilacs and very often on last year's peony stems which should have been cut to the ground in the fall, and going over from these to new growth. Other popular hosts are dogwood, ash, poplar, willow, red maple, silver maple, linden, horsechestnut, rose.

Another form of this scale, called the apple oystershell, is found chiefly in the northern two thirds of the country, on apple, pear, mountain-ash, quince, plum, raspberry, currant, almond, apricot, grape, fig, and Persian walnut.

Other plants, sometimes hosts to one or the other form, are ailanthus, alder, aspen, basswood, beech, birch, bittersweet, boxwood, boxelder, butternut, camellia, camphor, cherry, chestnut, clematis, cotoneaster, cranberry, elm, filbert, fir, ginseng, gooseberry, hackberry, heather, holly, honeysuckle, Juneberry, lime, locust, mountain holly, nectarine, New Jersey tea, oak, orchid, pachysandra, sassafras, spirea, sycamore, tamarisk, tuliptree, viburnum, Virginia creeper, English walnut, yucca.

The winter is passed as elliptical, nearly white eggs under female scales; they hatch late in spring, after trees have come into full leaf. The young are whitish with 6 legs, just barely visible; they crawl for a few hours, insert their beaks into the bark. The females molt and remain in that position; the males change into yellowish 2-winged insects which die after mating. As the female deposits her eggs under the shell her body gradually shrinks until death. There is one generation of the lilac form, often two of the apple oystershell scale.

Control. There are several parasites working on the female scales and a mite is effective in destroying eggs; birds sometimes feed on eggs and adults. Lilacs should be given a dormant spray every season, just before the buds break, using a miscible oil at a 1 to 15 dilution, or lime-sulfur diluted 1 to 8. Branches completely covered with scales should be cut off and burned before spraying. A summer application of nicotine sulfate and soap is sometimes needed for the crawling stage. A dormant spray used in apple orchards is a 3 to 5 per cent tar-distillate oil emulsion. Blue ash and hard maples are said to be resistant to oystershell scales. They can replace white ash and soft maples if the scale gets too serious in certain areas.

Palm Scale—See **Dictyospermum Scale.**

Peach Scale (*Lecanium persicae*)—Much like European fruit lecanium or brown apricot scale but longer, less convex. It occurs on English ivy, ginkgo, gooseberry, grape, holly, Japanese quince, mulberry, nectarine, oleander, peach, pear, plum, rose and silver thorn. It is not particularly injurious though it is large enough to be rather noticeable.

Peony Scale (*Pseudaonidia paeoniae*)—On twigs and branches of azaleas and camellias in the South. The scale covering is small, convex, round with a small nipple, and so resembles the brown of the bark that it is hard to see, except where it has fallen off to disclose white areas on the bark. Crawlers, purple in color, hatch from the first of April to the last of May. There is only one brood a year.

Control. Spray with Volck or other summer oil the last of May to kill the young crawlers; mature scales are resistant to sprays.

Pine Needle Scale (*Chionaspis pinifoliae*)—A native insect, generally distributed; very common in home plantings on nearly all species of pines and some spruces, occasionally recorded from hemlock, fir, incense cedar. The female scale is pure white, widening toward the lower end, varying in shape according to the needle it is on, $\frac{1}{10}$ inch long. The male is white, with four parallel ridges, $\frac{1}{25}$ inch long. Pine branches infested with scale usually turn yellow. On small Austrian and mugho pines every leaf may be white with scales, the needles yellowing, the whole shrubs most unhealthy looking. (Plate XXXV, page 366.)

Reddish eggs winter under the scales and start hatching in June. New scales reach maturity in August and continue egg-laying until late in the fall.

Control. Spray with miscible oil, oil emulsion, or lime-sulfur at a 1 to 9 dilution in spring before new growth starts, or with nicotine sulfate and soap in summer. Often only one branch on a pine is infested and can be pruned out without spoiling the shape too much. Ladybeetles and some hymenopterous wasps share in control measures.

Pineapple Scale (*Diaspis bromeliae*)—A tropical pineapple pest that is often present in greenhouses on canna, hibiscus, English ivy, olive, palm, sago palm, and various tropical plants. It has a nearly circular, thin, white or light gray shell over an orange-yellow body with purplish tints.

Pit-making Oak Scale (*Asterolecanium variolosum*)—Often injurious to young oaks in ornamental plantings. The scale is circular, slightly convex, greenish-gold, polished, with a marginal fringe and minute glassy spines. It makes small pits in the bark and lies in these depressions.

Control with a dormant miscible-oil spray.

Purple Scale (*Lepidosaphes beckii*)—The most important citrus pest in Florida and the Gulf states, not quite so serious in California, being

outranked there by California red scale and the black scale. It was first found in Florida in 1857 on lemons imported from Bermuda, and reached California in 1889 when two carloads of Florida orange trees were planted without previous disinfection. Besides citrus trees, purple scale infests, though with not so much harm, allamanda, avocado, banksia, bergamot, Barbados cherry, croton, elaeagnus, eucalyptus, fig, magnolia, mistletoe, jessamine, oak, olive, orchid, passion vine, pecan, sago palm, silver thorn, Spanish bayonet, and other plants.

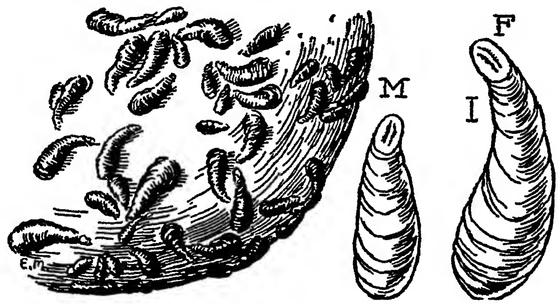


Figure 88

Purple scale on citrus fruit, with detail of oyster-shaped male and female

This is an armored scale, shaped like an oyster shell, straight or curved, from light to dark brown or purplish, 1/8 inch across. The male is similar but smaller and narrower. Foliage turns yellow where scales have been feeding, may even turn brown and fall out; fruit is stunted, ripening delayed, color and flavor affected. Feeding by purple scales also affords entrance to disease fungi. (Figure 88.)

The female deposits from 40 to 80 pearly eggs under her shell which hatch in 2 weeks to 2 months. The pale nymphs crawl for a short time, seek a shaded location on bark or fruit, insert their beaks, and settle down. After the first molt the scale is reddish or purplish-brown. After about 2 months of feeding the males acquire wings and mate with females. There are about three generations a year.

Control. In Florida best control is by oil emulsions (1.3 to 1.7 per cent actual oil) applied in May and again in July, a program which also controls whiteflies on citrus. In California cyanide fumigation under tents is preferred, but oil sprays can be used. There are some insect enemies.

Putnam Scale (*Aspidiotus ancylus*)—Very similar to San Jose scale but not a serious pest. It is circular, dark gray to nearly black, with brick-red exuviae, just off center. It has been found on apple, ash, beech, blueberry, bladdernut, cherry, chestnut, currant, cranberry, elm, gooseberry, hackberry, hawthorn, hickory, linden, locust, maple, osage orange,

oak, peach, pecan, persimmon, pear, plum, quince, snowball, tuliptree, willow, and walnut.

Red Date Scale (*Phoenicococcus marlatti*)—Common on date palm in California and Arizona but apparently not very injurious. Female is reddish-purple, resting in and somewhat enveloped by cottony filaments. The male is wingless. Food plants are restricted to 3 species of Phoenix palms.

Red Scale—See **California Red Scale** and **Florida Red Scale.**

Rose Scale (*Aulacaspis rosae*)—Widely distributed wherever roses or bramble hosts are known. This is a very conspicuous scale—round white female shields covering orange or pinkish bodies and red eggs, and very small, narrow white males. Scales often so cover lower portions of canes that they look as if whitewashed. Blackberries, loganberries, raspberry, dewberry, strawberry, thimbleberry, and related plants may be infested, also pear, myrtle, mango. Neglected roses, climbers and hybrid perpetuals, are more likely to be infested than hybrid teas pruned back each spring. In New York eggs hatch in late May or June, with a second generation in August.

Control. If roses are sprayed with lime-sulfur at a 1 to 9 dilution, directly after pruning in spring (if buds have broken less than 1/4 inch by that time), rose scale is readily controlled. For climbers near painted surfaces and for other hosts, use miscible oil diluted 1 to 15 or 1 to 20. Prune out canes too well supplied with scales.

San Jose Scale (*Aspidiotus perniciosus*)—Probably from China, first discovered at San Jose, California, in 1880 and now present in every state; doubtless our best-known scale insect. It is particularly injurious to deciduous fruit trees, often causing death if left unchecked. Fruit hosts include apple, pear, quince, peach, plum, prune, apricot, nectarine, sweet cherry, currant, gooseberry; while ash, mountain-ash, poplar, hawthorn, lilac, linden, elm, and willow are also subject to injury.

Other host plants are acacia, actinidia, akebia, alder, almond, arborvitae, beech, birch, false bittersweet, blackberry, buttonbush, buckthorn, catalpa, ceanothus, chestnut, cotoneaster, dogwood, elder, eucalyptus, euonymus, fig, hackberry, hibiscus, honeysuckle, locust, loquat, maple, mulberry, pecan, orange, osage orange, persimmon, photinia, privet, Japanese quince, rose, sassafras, shadbush, silver thorn, smokebush, snowball, snowberry, spirea, sour gum, strawberry, sumac, Virginia creeper, English walnut, willow.

The female is yellowish covered with a gray, circular, waxy scale, 1/16 inch in diameter, elevated in the center into a nipple surrounded by a yellow ring. Young scales are small and nearly black. The male is oblong, oval, acquires 2 wings. Sooty black young scales winter on bark, growing

when sap flows in spring, full-grown when apple trees bloom. After mating, the females give birth to living young, crawlers with 6 legs which move over the bark until they find a suitable place to insert their mouth parts.

There are two to six generations a year, depending on location. The scale is spread by being carried on the bodies of birds, by larger insects, and through shipments of infested nursery stock.

Control. Lime-sulfur first came into use as a dormant spray in controlling San Jose scale, and may still be satisfactorily used at a dilution of 1 part to 8 gallons of water in spring just before buds burst. Oil emulsions are now preferred by orchardists; standard brands are on the market. There are many parasites and some ladybeetles which help to control San Jose scale.

Scotch Pine Lecanium, or **Pine Tortoise Scale** (*Toumeyella numismaticum*)—Occurs on Scotch, Austrian, and Jack pines in Michigan, Wisconsin, and probably other states. Reported as causing death to young Jack pines. Females are oval, very convex, with surface of scale pitted or irregular, reddish-brown, coated with a thin layer of wax, averaging 1/4 inch long. Males are much smaller, flat, elongate, with a transparent glassy appearance. Both appear around twigs at base of needles and secrete immense quantities of honeydew. They appear in the fall to mate with females; their empty white pupal cases remaining attached to twigs make the latter look scurfy. The injury is confined to lower branches with an infested limb usually killed in one season. There is heavy foliage drop, with other needles foreshortened.

Control. Spray with miscible oil or oil emulsion in spring before growth starts, with as much pressure as possible.

Scurfy Scale (*Chionaspis furfura*)—A native pest of deciduous fruit and ornamental trees widely distributed from Canada to Georgia and west to Utah. The female is grayish-white, rounded at one end so it is rather pear-shaped, 1/8 inch long; the male is smaller, snow-white, narrow with 3 longitudinal ridges. (Plate XXXVI, page 367.) The scales may be abundant on bark, giving it a scurfy appearance, and fruit is sometimes spotted. They are most often present on shaded parts of trees in neglected orchards where the foliage is too dense. Scurfy scale is not important on trees receiving good care.

Food plants include pear, apple, quince, gooseberry, currant, black raspberry, and peach for fruits, and many shade trees, such as mountain-ash, white and prickly ash, horsechestnut, willow, black walnut, elm, hawthorn.

Reddish-purple eggs winter on bark under female shells, hatching in late spring (May or June) after trees are in full leaf. Purple crawlers move

about for a few hours, then settle down on bark. There are two generations a year in the southern range of this insect, with eggs of the summer generation laid in July, overwintering eggs laid in late August and September. There is only one brood in northern states.

Control. Dormant oil emulsions containing 2 to 3 per cent dinitro-o-cyclo-hexylphenol, known as DN Oils and available commercially, seem to give best control by killing the eggs. A summer-oil-and-nicotine spray is effective against crawlers.

Soft Scale (*Coccus hesperidum*)—Often known as soft brown scale, widely distributed in greenhouses and outdoors in warm climates on ornamentals and fruits. Although one of the tortoise scales, it is rather flat, soft, brown or pale yellow with a brown marbled effect, sometimes greenish, usually resembling the host plant and staying unnoticed until the infestation is very large. Young are born alive, 1 or 2 daily for a month or two; they are sluggish, settling down near the parent and maturing in about 2 months. A large amount of honeydew is produced, resulting in much smutting of foliage. It is considered the most destructive flat fern scale.

Host plants, indoors and out, include abutilon, aloe, apple, apricot, aralia, araucaria, ash, avocado, banana, bougainvillea, boxelder, bursera, camellia, cassia, citron, clematis, clerodendron, date palm, ferns, fig, gardenia, grape, grapefruit, guava, hawthorn, hibiscus, holly, English ivy, jasmine, Kentia palm, laurel, California laurel, lemon, locust, madroña, magnolia, manzanita, maple, morning glory, mulberry, myrtle, oleander, orange, peach, pear, phlox, pittosporum, plum, poinsettia, poplar, prune, rose, sago palm, strawberry tree, water hyacinth, willow, and many others.

Control. There are a large number of parasites which do an excellent job of controlling soft brown scale. It is also readily killed by fumigation in greenhouses or by summer oil sprays, indoors or out.

Spanish Red Scale—See **Dictyospermum Scale.**

Spirea Scale (*Eriococcus borealis*)—Occasionally infesting *Spiraea thunbergi* and perhaps other spireas. It is a white mealy scale in forks of branches and resembles azalea mealybug.

Control by spraying with pyrethrum or nicotine sulfate and soap.

Spruce Bud Scale (*Physokermes piceae*)—A special pest of Norway spruce but present on other conifer species. Mature scales are ⅛ inch across, round, gall-like, reddish-brown with flecks of yellow and dusted with powdery wax, situated in clusters of 3 to 5 at base of branchlets and so closely resembling spruce buds that they are difficult to detect. Infestation is chiefly at tips of lower branches. Great quantities of honeydew attract bees. Young insects are born in July and winter as part-grown scales. There is one generation.

Control. Use a dormant oil spray in spring before growth starts or a summer nicotine-and-oil spray when young are present.

Sycamore Scale (*Stomacoccus platani*)—Occuring naturally on native sycamore in California and now a serious pest of introduced oriental plane. The female scale is deep yellow, 1/16 inch long. It winters on bark of trunk and branches protected by loose cottony threads. The nymphs migrate to the leaves in spring, producing brown spots by their sucking. Leaves are often deformed and may drop prematurely.

Control. Apply a dormant-oil sprav thoroughly to the bark in winter.

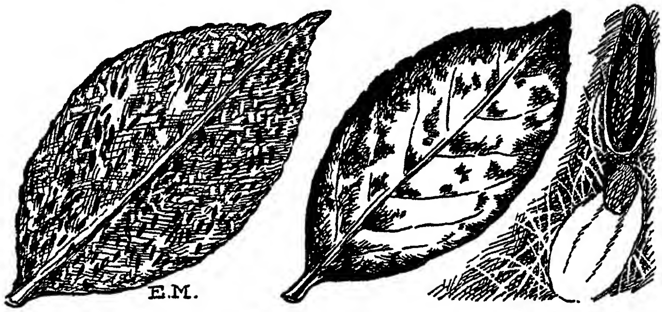


Figure 89

Tea scale on camellia, showing brown females and nymphs covered with white cotton on underside of leaf and yellowing of upper leaf surface

Tea Scale (*Fiorinia theae*), also known as the **Camellia Scale**—The most important pest of this host, being practically inevitable on outdoor camellias in the South and found also on greenhouse plants. Although the scales are on underside of leaves, infested camellias can be told at a distance by yellowish blotches on upper leaf surfaces, generally unhealthy appearance of whole shrubs, and premature dropping of leaves. Production of blooms is decreased and cuttings may die before roots develop. Ferns, palms, orchids, figs, and some other plants may be infested.

The female is first thin and light yellow, later hard, brown, rather oval, 1/20 inch long, with the residue from first molt attached at one end. Yellow eggs, 10 to 16, are held under the shell. The male is soft, white, narrow, with a ridge down the middle. Both scales are held in a conspicuous tangle of white cottony threads; often the entire under leaf surface is white dotted with small brown female shells. (Figure 89.)

The eggs hatch in 7 to 21 days, depending on the weather. Flat yellow crawlers move to newer growth, attach themselves after 2 or 3 days, secreting first a thin white covering and later the many white threads. The first molt is in 18 to 36 days, the second a week later; egg-laying starts from 41

to 65 days after birth. There are many overlapping broods, so that crawlers and young nymphs are present on foliage at any time between March and November (Alabama calendar).

Control. Spray thoroughly in spring after blooming and when cold weather is past (about April 1), using a white oil emulsion such as Florida Volck at 2 to 100 gallons or 6 level tablespoons per gallon, hitting underside of leaves with great force. A second application may be required later in the spring or in September. Natural enemies are not much help in controlling tea scale.

Terrapin Scale (*Lecanium nigrofasciatum*)—A native insect present over most of eastern and southern United States. It attacks all common fruits, many shade trees, and shrubs. A partial list of hosts includes soft and sugar maple, sycamore, cherry, peach, plum as preferred food plants; with occasional infestation on ash, hard maples, mulberry, cottonwood, live oak, redbud, willow, linden, chestnut, European plane. Terrapin scale is normally a twig and branch insect.

This is a soft, unarmored scale, the female nearly hemispherical, 1/8 inch in diameter, dark reddish-brown, smooth, shining, with 10 or 12 dark bands radiating from the high center of the back to the fluted edges. Partly grown females winter on twigs, reach full size in June when they start to give birth to living young. Each nymph leaves the mother in a day or two, migrates to a leaf for 6 weeks, then moves back to the branches where it is fertilized by a minute winged male. When scales are numerous, twigs are said to give off a semi-putrid odor; the drain on the tree is serious; smaller branches die, the foliage is thin. Sooty mold grows in quantity in the honeydew which covers trunk and branches and drops to sidewalks underneath.

Control. There are many predaceous and parasitic insect enemies. Lime-sulfur seems to have little effect on this scale. A miscible oil, at a 1 to 16 dilution, applied as late in the spring as possible before buds burst, is effective but must be used cautiously on maples. Nicotine sulfate and soap for the crawling stage would be safer for some species, such as sugar maples.

Tessellated Scale (*Eucalymnatus tessellatus*)—A tropical tortoise species appearing in greenhouses on many kinds of palms, laurel, orchids, and other plants. It is like the soft scale but larger, darker brown, with the surface marked with pale lines to make a mosaic.

Tuliptree Scale (*Toumeyella liriodendri*)—Distributed over the United States east of the Rocky Mountains, on tuliptree for the most part, but sometimes on magnolia and linden. This is probably a native insect, and was noted as injurious in Michigan as early as 1870. It is one of the largest of the soft scales; the female is often 1/3 inch across, very convex, hemi-

spherical, a rich dark brown. Scales are often crowded together and distorted in shape.

The winter is spent as small, partly grown nymphs, brown with lighter ridges, clinging tightly to twigs. They grow fast in spring and are producing young by August. There is one generation.

Control. Spray with a dormant oil emulsion in spring. During the season large scales can be scrubbed off twigs or small ornamentals with a rag and soapy water.

Walnut Scale (*Aspidiotus juglans-regiae*)—A European scale rather widely distributed. The female body is mottled orange, covered with a flat, nearly circular gray to reddish-brown shell, 1/8 inch in diameter. In addition to English, Persian, and Japanese walnuts, food plants include apple, apricot, ash, boxelder, cherry, cherry laurel, cottonwood, currant, dogwood, elm, grape, sweet gum, gordonia, haw, holly, hackberry, horse-chestnut, linden, locust, maple, oak, peach, pear, plum, prune, and rose.

Control. Spray thoroughly with lime-sulfur, 1 to 8, just before buds expand in spring.

White Peach Scale (*Pseudaulacaspis pentagona*), also known as **West Indian Peach Scale**—Present from Florida north to Maryland and occasionally farther up the coast. It is an armored scale. The female is circular, light gray or dingy-white, with yellowish exuviae; the male, elongated, pure white, often clustered at base of the branch. Not so much of a pest as once feared, it does attack fruits—peach, plum, prune, cherry, pear, apricot, grape, and some ornamentals, including privet, lilac, catalpa, flowering peach and cherry, persimmon, and walnut.

Control. Spray with dormant lime-sulfur or a miscible oil.

Willow Scale (*Chionaspis salicis-nigrae*)—A common scale in willow over the United States and also infesting poplar, dogwood, shadbush, tuliptree, alder, ceanothus. The female is large, white, often pear-shaped but broadest at the middle; the male is long, narrow, snow-white. Purple eggs winter under the female shell; there are two generations in this part of the country. Twigs and branches of willow may be coated with scales which kill branches or young trees.

Control. Spray with lime-sulfur at dormant strength just before buds break, or use miscible oils with due precaution.

Zamia Scale (*Diaspis zamiae*)—Reddish with a prominent convex shield which is waxy with marked radial stripes.

SLUGS AND SNAILS

Slugs and snails are not insects but mollusks, belonging, along with oysters, clams, and other shellfish, to the large animal phylum Mollusca, characterized by individuals which have soft unsegmented bodies, usually protected with a hard calcareous shell. A slug is merely a snail without a shell, or with a shell reduced and located internally. (Plate XXX, page 279.) Mollusks have 2 pairs of antennae, one for feeling and the other with eyes at the tips. They are hermaphrodites, with male and female reproductive organs in the same individual.

Land snails have been regarded as delicacies by some peoples since Roman times, and snail preparations were used in medicine in the distant past. The snail of devastating consequence to the gardener is the European brown snail.

There are both land and marine slugs, the latter usually called sea slugs. Most of the land forms are plant-feeders, but there is one slug (*Testacella* sp.) which is predaceous on earthworms. There are several species of slugs, widely distributed across the country, but the West coast, and California in particular, seems to have more than its fair share. Dr. E. O. Essig reports that the enormous native yellow slugs (*Agriolimax* spp.), which occur through coastal and mountainous regions of California, are occasionally injurious to garden vegetables but that 7 introduced species are the worst offenders.

Fern Snail (*Agriolimax laevis*)—A naked snail, ½ to ¾ inch long, dark gray in color. It hides in the soil during the day and at night feeds on parenchyma tissue from the underside of the leaves.

Control. Spray underside of fern fronds with nicotine sulfate and soap early in the morning; remove snails by hand.

Giant, or Large Gray Slug (*Limax maximus*)—Light gray with large, irregular black spots, ranging from 4 to 8 inches long, with clear, uncolored slime.

Gray Field Slug (*Deroceras gracile*)—Common in lawns and fields, the color varying from uniform buff to black, ¾ to 1 inch long.

Gray Garden Slug (*Deroceras agreste*)—The commonest slug, very destructive to vegetable and field crops, buff to gray with varying black spots, 1½ to 2 inches long, producing milky slime when irritated.

Greenhouse Slug (*Limax gagates*)—Widely distributed, very destructive, uniform black to dark gray, with a longitudinal ridge down the body and a diamond-shaped mark in the center, 1½ to 3 inches long. Shows some preference for coleus, cineraria, geranium, marigold, and snapdragon.

Long-necked Slug (*Deroceras laeva*)—Having an orange-brown area with scattered black spots on the mantle in midpart of the body, the rest brown or grayish, 1½ to 2 inches long, the neck very long when extended, slime clear.

Small Striped Slug (*Limax marginatus*)—Light brown with gray or black bands, mostly a lawn problem.

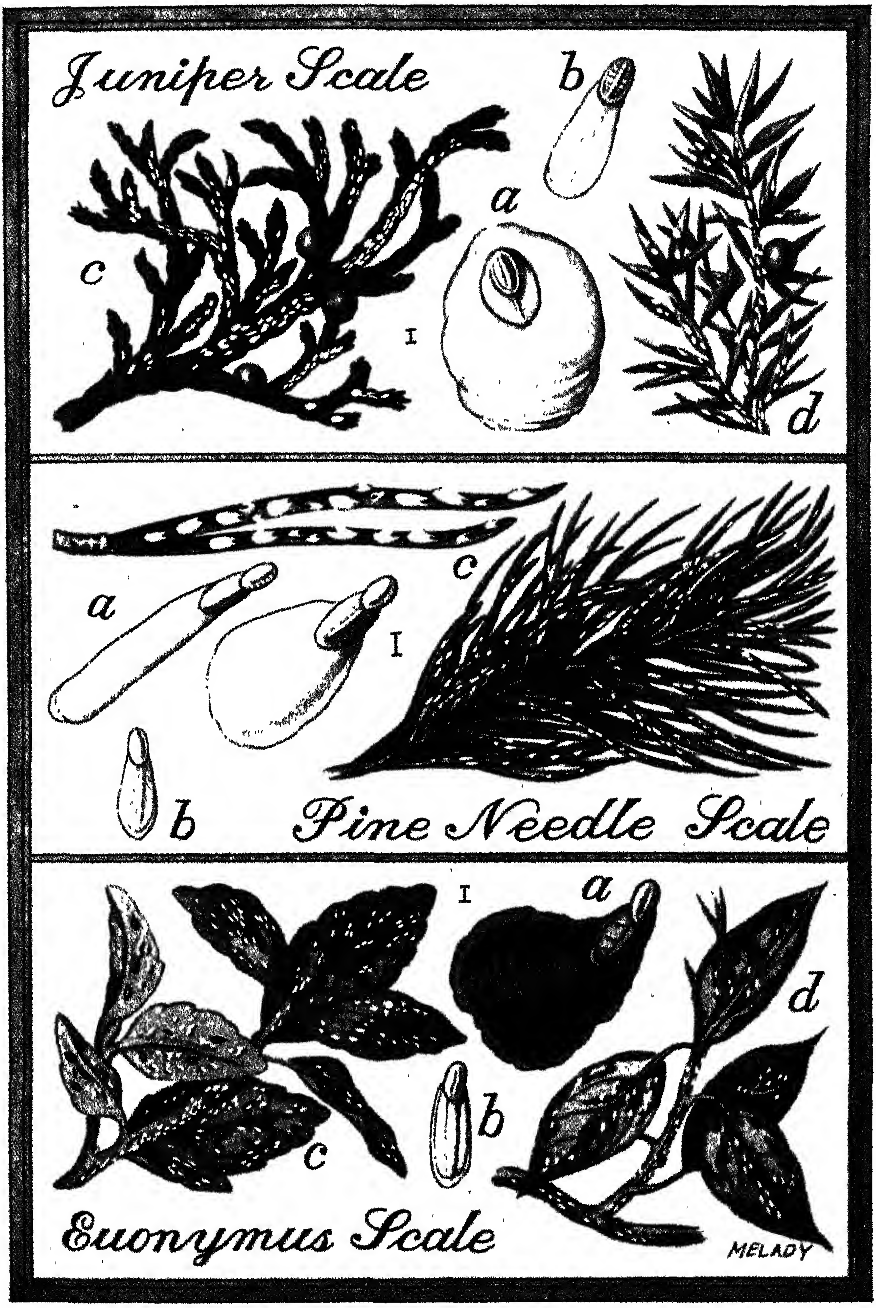
Spotted Slug (*Limax flavus*)—Greenish-brown with spots of yellow, bluish head and tentacles, often 3½ to 4 inches long with conspicuous slime.

Figure 90

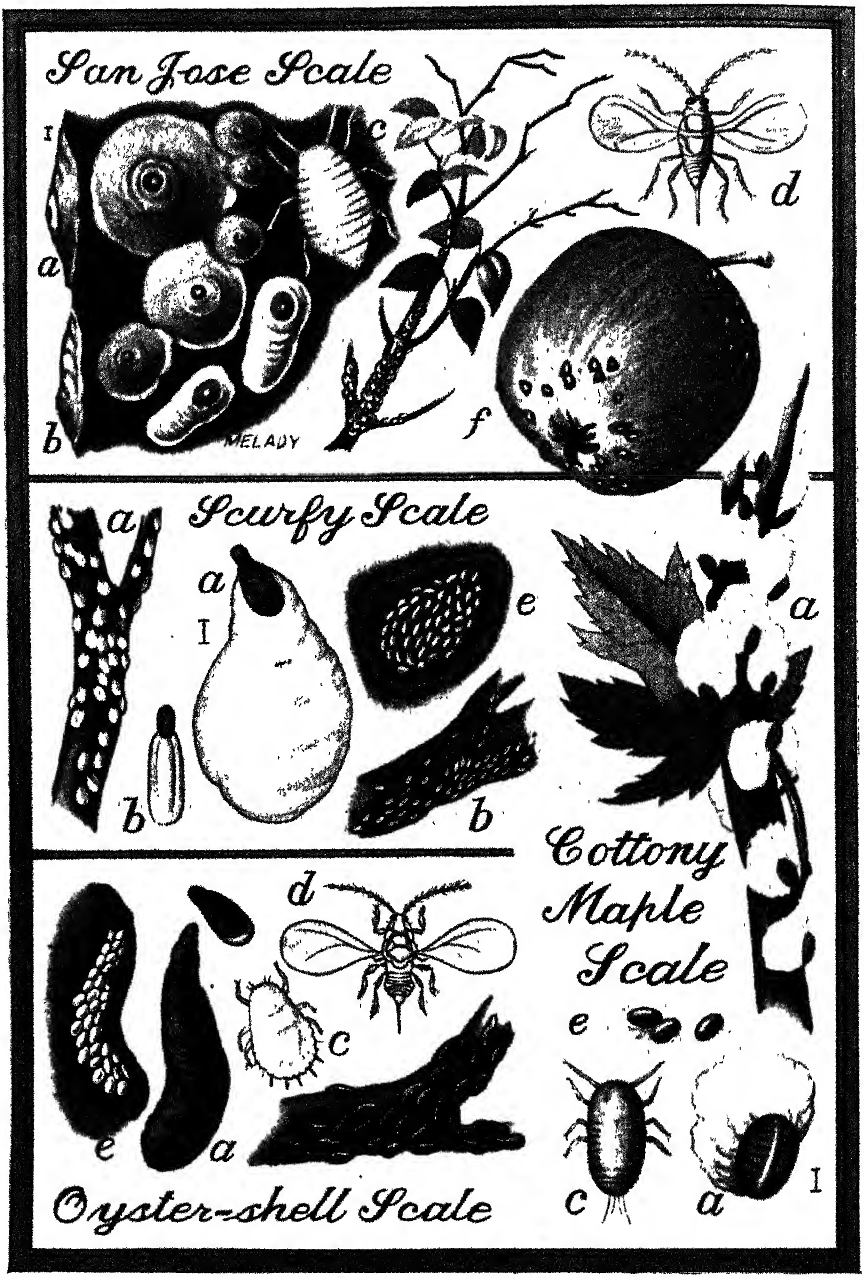
Slug injury to hollyhock

Slugs work at night, extending their slimy length over leaves, eating out large holes, and leaving behind a viscous trail, yellow or milky or colorless, according to the species. Slugs are among the earliest pests to start chewing in the spring and they keep on late into the fall. Hollyhock leaves almost always show slug holes, and so do those of many other ornamentals where the foliage is close to the ground. (Figure 90.) Primroses seem a special delicacy for slugs, and they are often found hiding at the base of iris leaves, or in delphinium crowns, or inside cabbage or lettuce heads, or feeding on coleus, cineraria, geranium, marigold, or snapdragon, among others, in the greenhouse.

Slugs lay pearl-shaped eggs in jelly-like masses in damp places in the garden, or under boards or flower pots. The eggs are held together by a sticky secretion which turns yellow just before they hatch. The young, resembling adults except for size, develop slowly. Slugs live a year or more.



XXXV **JUNIPER SCALE:** **(a)** round white female scale (much enlarged); **(b)** male scale (same enlargement); **(c, d)** scale on juniper twigs. **PINE NEEDLE SCALE:** **(a)** 2 forms of female scale (much enlarged); **(b)** ridged male scale; **(c)** infested pine needles. **EUONYMUS SCALE:** **(a)** dark oyster-shaped female (enlarged); **(b)** narrow, white ridged male; **(c)** infested euonymus; **(d)** bittersweet with euonymus scale.



XXXVI **SAN JOSE SCALE:** **(a)** round female scales; **(b)** oblong male scales; **(c)** young crawler; **(d)** adult winged male; **(f)** infested apple twig and fruit. **SCURFY SCALE:** **(a)** single female (greatly enlarged), and branch bearing all female scales; **(b)** male (enlarged), and branch infested with male scales; **(e)** female scale removed, showing eggs. **OYSTERSHELL SCALE:** **(a)** female (much enlarged), and branch infested with females; **(c)** young crawler; **(d)** adult male; **(e)** female turned over to show eggs under shell. **COTTONY MAPLE SCALE:** **(a)** female with cottony egg mass, and infested maple twig; **(c)** young crawler; **(e)** eggs (enlarged).

Control. Cleaning up the garden to get rid of hiding places is always effective. Removing old iris leaves after the first frost, leaving only new fans, not only outwits borers but makes slugs homeless. Shingles in the garden will trap slugs, ready for mass executions. The most modern baits have a base of metaldehyde, often combined with calcium arsenate. Such baits attract slugs as well as kill them and are available under trade names: Arione, Bug-Geta, Metameal, Snarol, and others. Bug-Geta now comes in convenient pellet form.

Lacking one of these commercial preparations, a home-mixed bran bait as suggested for millipedes can be used; or, better, a home mixture of 4 grams metaldehyde to a quart of bran barely moistened with water.

False slugs are larvae of sawflies, which because of their shape and rather slimy appearance are commonly given the name of slugs. Pear, rose, and cherry slugs are considered under sawflies.

European Brown Snail (*Helix aspersa*)—Distributed over the world, known in California since about 1850, where it was apparently deliberately "planted" for food purposes from stock brought from France. It is now destructive to many grasses, vegetables, flowers, shrubs, and trees, and very numerous in citrus orchards, eating holes out of leaves, making pits or scars on fruit—so numerous on tree trunks that they are covered with snail shells.

The background color is grayish-yellow, but brown is applied in 5 interrupted or sometimes united, bands. Full-grown shells have 4 to 4½ whorls, are an inch or more in diameter. The mouth is surrounded by fleshy lips, but inside there is a chitinous jaw to cut or scrape off food. White spherical eggs are laid in a nest in the soil. The young snail has only 1 whorl when hatched and takes about 2 years to reach maturity.

Control. Hand-pick the snails; surround trees with a barrier of lime on the soil, which acts as an irritant and keeps snails from walking through it; use baits as for slugs or a mixture of 1 ounce calcium arsenate to a pound of bran mixed dry with water to barely moisten. Scatter this bait like grains on the ground under trees as far as the foliage extends, and around garden plants and bushes where snails hide during the day.

White Snail (*Helix pisana*)—Of some importance on citrus trees in California. Typically the shell is buff with brown stripes, but some snails are white with no stripes. This species is slightly smaller than the brown snail.

Control methods are the same.

SKUNKS—See under **Mammals**.

SOWBUGS AND PILLBUGS

Sowbugs are small animals belonging to the class Crustacea, which includes all arthropods having 2 pairs of antennae, at least 5 pairs of legs. Most crustaceans are of aquatic or semi-aquatic habit, but many sowbugs are terrestrial, though usually found on damp soil or on damp wood or under wet leaves or wet flower pots or, as house pests, in damp basements. Sometimes sowbugs are called wood lice.

Sowbugs are related to crayfish. They have flat, oval, gray to brown segmented bodies with 7 pairs of legs, and are about ½ inch long when grown. (Plate XXX, page 279.) One species, the common pillbug (*Armadillidium vulgare*), has a habit of rolling up into a ball like an armadillo, which it resembles in miniature. The dooryard sowbug (*Porcellio laevis*) and the scabby sowbug (*Porcellio scaber*) are common species which do not roll into a ball when disturbed.

The female sowbug has a ventral pouch known as a marsupium. The eggs are laid in it and held for 2 months and then the young, in broods of 25 to 75, are left there for some time longer. Young sowbugs are similar to adults; they take a year to mature.

Pillbugs are more numerous and destructive than other sowbugs, most dangerous to seedlings in greenhouses and lathhouses but sometimes injuring garden or field crops, working on roots and tender growth.

Control. A dust composed of 5 pounds calcium arsenate and 2 pounds white flour, spread thinly over 1,000 square feet of soil area, seems somewhat more effective in gardens than other poison baits. In greenhouses the standard sowbug treatment is a mixture of 1 part of paris green with 9 parts of sugar. Half of the sugar can be replaced with flour, corn meal, or middlings with almost equal results. Another bait when sugar is scarce is a mixture of 2 level tablespoons paris green, 3 pints of bran, and 1 cup of fish meal (available at stores selling cattle feed). These baits are mixed dry and placed on small wood or tin plates at intervals throughout greenhouse beds. If used outdoors some sort of cover should be arranged. Proprietary baits sold for slugs, and advertised as also controlling sowbugs, have not given as good results in controlled experiments as the paris-green baits.

SPANWORMS

Spanworms are caterpillars with the looper or measuring-worm habit.

Currant Spanworm (*Itame ribearia*)—Present in various parts of the East and in Colorado, feeding on currants and gooseberries, sometimes

blueberries and huckleberries. The worms are whitish with yellow stripes and many prominent black dots. Like other loopers they drop down on a silken thread when disturbed. Sometimes they are numerous enough to defoliate the bushes. The moths have slender bodies, with broad yellow wings marked with black. Eggs are laid in stems in summer, hatching the next spring when leaves are out.

Control. Use rotenone dusts or sprays.

Elm Spanworm (*Ennomos subsignarius*)—The snow-white linden moth, distributed south to Georgia and west to Colorado. Some time before 1880 this species was very abundant around New York and Philadelphia and about 1910 it was numerous in forest areas in the Catskills; there was a major outbreak in Massachusetts in 1914 and one in Connecticut in 1938. It is a city pest and in outbreak years it defoliates maple, beech, linden, elm, horsechestnut, and other trees, but there are evidently long periods between epidemics.

The worm is about 2 inches long, brownish-black with irregular yellow markings. The moth is pure white with a wingspread of 1½ inches. Eggs are laid about midsummer, in groups on branches, and do not hatch until the next spring. Larvae begin at once to devour foliage, grow rapidly, and pupate in a loose cocoon in a crumpled leaf. When the moths appear in late July they migrate long distances, appearing in cities like a summer snowstorm.

Control. The English sparrow is credited with doing a grand job of ridding cities of this pest, helped along by at least 2 insect parasites. In years of peak infestation have trees sprayed with lead arsenate as soon as they come into leaf.

Hemlock Spanworm (*Ellopia fiscellaria*)—See **Hemlock Looper.**

Limetree Spanworm (*Erannis tiliaria*)—Occurring on basswood east of the Rocky Mountains and sometimes on apple, elm, and some forest trees. The female moth is wingless, with 2 rows of black spots down the back, about ½ inch long. The male has light buff fore wings marked with a dark wavy line and light hind wings. The looper caterpillar is bright yellow with 10 crinkly black stripes and a rusty-yellow, rough head. Eggs winter on the tree, hatch when buds burst; loopers feed for a month, then wander down to the ground to pupate in the soil; moths emerge in fall.

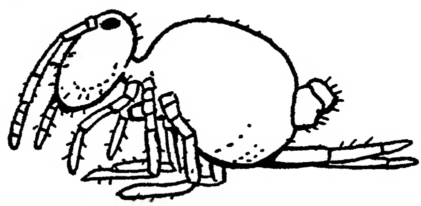
Control. Trees can be banded as for cankerworms but it is much better to have them sprayed with lead arsenate when they come into leaf.

SPRINGTAILS

Springtails belong to the insect order Collembola, a group of small insects less than ⅕ inch long without wings and with almost no metamor-

phosis. They have short antennae with few segments, an abdomen with not more than 6 segments, the first provided with a forked appendage (the collophore), and the fourth with an organ which enables springtails to spring or hop like fleas. There are many species present on the surface of stagnant water, in woodland soil, in decaying vegetable matter, in mushroom houses, and other damp places. One species, the snow-flea, is found on the surface of snow in early spring. Only one species is of much interest to gardeners.

Figure 91



Garden springtail

Garden Springtail (*Bourletiella hortensis*)—A black, active species found most often on young plants in seedbeds and outdoor gardens. The insects are black to dark purple with yellow spots, a round soft body, very distinct head, very small, 1/25 inch long. They jump quickly by means of the tail-like appendage. (Figure 91.) They chew holes in leaves and may almost defoliate seedlings of cabbage, cauliflower, beets, and some other vegetables. Most serious injury is on small plants close to the ground.

Control. Spray with nicotine sulfate and soap, or apply nicotine dust.

Squirrels—See under **Mammals.**

TERMITES

Termites are not ants, though often called white ants, but they are social insects like ants, living in galleries in wood or in the ground except when the winged forms are swarming. Their colonies consist of nymphs, soldiers, workers, and reproductive adults. They belong to the order Isoptera, meaning equal or similar wings, which are long and narrow, superimposed flat over the back when at rest. The best way to tell termites from ants is to look at the "waist." Ants are deeply constricted while termites have a broad joining between thorax and abdomen. (Figure 92.) Termites have chewing mouth parts, but a gradual metamorphosis. They are relatives of cockroaches.

Termites have a well-developed caste system with: 1, primary reproductive members, kings and queens—sexual forms with wings which escape from the colony to found a new one, losing their wings after migrating; 2, secondary reproductive members—mature males and females without wings but with wing buds, which take charge in case the king and queen are killed; 3, ergatoid kings and queens—sexually mature but lacking wings entirely; 4, workers, blind, pale, wingless—non-reproductive, constituting the main population of the colony; 5, soldiers—wingless insects with enlarged heads and mouth parts.

The food of termites is wood or cellulose in some form and they have protozoa in their intestines which enable them to digest this cellulose. Some termites live in dry wood above ground, but the most important species to the householder and gardener are the soil-inhabiting forms—particularly the eastern subterranean termite (*Reticulitermes flaviceps*) and the western subterranean termite (*Reticulitermes hesperus*). These forms live in the ground but work on wood on or in the ground or build covered runways to reach wood above the ground. They are not new pests, as some termite-control operators advertise, since they have been found in fossils and were probably on this continent before man himself. Their periods of abundance do seem to be in waves, however, and there are some years when damage to buildings seems abnormally high.

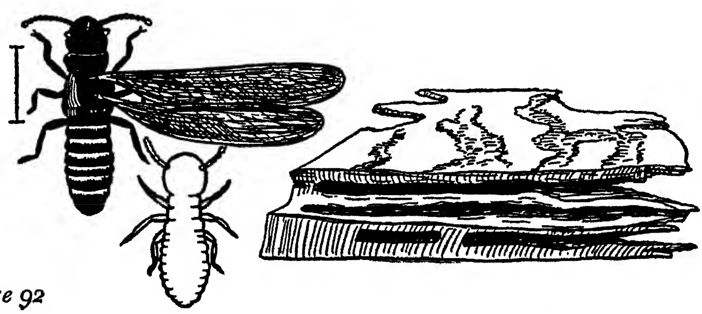


Figure 92

Termites—winged sexual form and nymph, and wood tunneled by termites. Note thick "waist" compared to true ant

Subterranean termites sometimes injure living trees and shrubs, being somewhat more harmful in southern states and California. In Florida they eat away the bark in a collar around newly planted orange trees. Other trees in warm climates may be injured—apple, peach, pear, cherry, plum, apricot, lemon, guava, pecan, chestnut, walnut. Usually the injury is worse in recently cleared woodland containing old decaying stumps or in land rich in humus. Fruits which drop and lie on the ground may be

invaded. In cities, roots and heartwood of shade trees may sometimes be attacked by termites. Subterranean termites may injure tree seedlings or other stock in nurseries.

Shrubs and flowers with woody stems may be infested in gardens or greenhouses, the termites often starting on decaying wooden stakes or labels in the garden or in old greenhouses which have wooden benches in contact with moist earth. Heliotrope, begonia, bedding geraniums, chrysanthemums, poinsettias, cosmos, jasmine, pansies, and oleanders have all been seriously injured by termites on occasion. Termites reach potted plants through a hole in the bottom of the pot. In southern states field and truck crops may be injured—corn, cotton, sugar cane, rice, grasses, white and sweet potatoes, artichoke, bean, beet, cabbage, carrot, cranberry, peanut, rhubarb, squash, turnips, cantaloupe, and other melons are on the list.

In California the desert damp-wood termite (*Kalotermes simplicicornis*) sometimes severely injures rootstalks of young citrus trees, while the dry-wood termite feeds on aboveground dead citrus wood.

Control. Use resistant wood for garden posts and stakes—redwood is excellent for grape stakes and fence posts—or use wood treated with creosote, zinc chloride, or chloride of mercury. Tree surgery and cleaning up old grapevines and other woody debris around the garden reduce the termite menace. Paint pruning scars with a mixture of one fourth creosote and three fourths coal tar after shellac has been applied to protect living tissue at edges of the bark.

Subterranean termites can be killed in soil around trees by applying carbon-bisulfide or carbon-tetrachloride emulsion. Poke small holes around plants 6 inches apart and pour in about an ounce of the emulsion.

Lead arsenate as used in grub-proofing against Japanese beetles is quite toxic to termites and can be used in soil around such trees, shrubs, and plants as do not object to it. Thiocyanate sprays, Loro or Lethane, can be used to soak the ground around flowers and other ornamentals infested with termites. Sap pine stakes can be used to trap termites, pulled up occasionally, and the insects killed with boiling water. When swarming indicates the position of a colony, drench the spot with kerosene.

In greenhouses proper construction makes termites unnecessary. In older houses benches can be cleaned up with kerosene emulsion.

THRIPS

Thrips belong to the insect order Thysanoptera, which means tassel wings. They are very small, slender insects, about as wide as a fine

needle and only just visible to the naked eye. The 2 pairs of narrow wings are edged with long hairs like a stiff fringe, whence the tassel-wing name. The mouth parts are fitted for piercing and rasping; metamorphosis is gradual; antennae have 4 to 9 segments; tarsi (feet) have 1 or 2 segments and end in a bladder-like vesicle.

Thrips feed by sucking plant juices, and they often scar fruit and foliage with their scraping mouth parts. They are commonly found on flowers as well as other plant parts. A few thrips are predaceous on mites, some eat fungi and decayed vegetable matter, but most are very injurious. Gladiolus thrips, onion thrips, and flower thrips on rose are of special concern to gardeners.

Banded Greenhouse Thrips (*Hercinothrips femoralis*)—A pest in greenhouses, but also the sugar-beet thrips. It is dark brown or black with head, prothorax, and end of abdomen reddish-yellow, fore wings dusty with white areas. It is found on alstroemeria, amaryllis, aralia, buddleia, calla, chrysanthemum, dracaena, rubber plant, gardenia, gladiolus, hydrangea, nerine, hymenocallis, screwpine, begonia, and other greenhouse plants, including young sweet potato and tomato seedlings, and outside on sugar beets and cacti in California; on date palm in Arizona.

Control as for greenhouse thrips.

Bean Thrips (*Hercothrips fasciatus*)—Widely distributed, a general feeder on leguminous plants, truck, field, and forage crops, grasses, deciduous and citrus trees. It is a special pest of beans, avocado, olive, pear, and orange in California and Arizona. Nymphs are reddish-yellow, adults are gray-black with banded black-and-white wings. They feed in colonies, making foliage of beans, peas, and other crops bleached or silvered, wilted, covered with black bits of excrement.

Control. Eliminate weeds around the garden, especially prickly lettuce, and sow thistle. Dust annual crops with pyrethrum. Spray pears and other deciduous fruits with a 1 to 100 dilution of a summer oil, plus ½ teaspoon of pyrethrum concentrate per gallon.

Blueberry Thrips (*Frankliniella vaccinii*)—A pest of blueberries in Maine and part of New York, known since 1926. Adult thrips appear when first blueberry leaves separate in the buds, causing a tight curling, reddening, and malformation of leaves. The female has thorax and part of antennal segments light brown; head, legs, wings, and first antennal segments gray.

Control. The recommended procedure is a quick burning over of blueberry fields; experimental work indicates that kerosene emulsion applied to the soil is effective.

Camphor Thrips (*Liriothrips floridensis*)—Very injurious to camphor trees in the Gulf states. The adult is black, 1/50 inch long; the young are

straw-colored changing to orange-red at the second molt. They feed on buds and tender tips, causing dieback, and on branches, causing blackening, cracking of bark, often deformation of limbs. Breeding is nearly continuous. Injury is worse on nursery trees, or on older trees which have been trimmed and cut back.

Control. Apply shellac to pruning cuts. Have trees sprayed with a solution of 2 quarts lime-sulfur plus 2 quarts fish-oil soap, plus ½ pint nicotine sulfate to 50 gallons of water.

Christmasberry, or **Toyon Thrips** (*Rhynchothrips ilex*)—Found in California on *Photinia arbutifolia.* It was supposed to breed exclusively on the toyon until an infestation was found in 1939 on sugarbush. The adult is black, glossy, with silvery-white wings. It hibernates in curled leaves, mates in early spring, starts feeding in new unfolding leaves and laying yellow waxy eggs loosely on the leaves. The larvae, at first pale yellow and then reddish, feed with the adults on new growth, causing it to become distorted, curled, sometimes killed. When mature, larvae drop to the ground to pupate, rest while the toyon is in bloom, and then the new adults feed on the second rush of new growth appearing after blooming. Natural spread is very slow; most dissemination is on nursery stock.

Control. Pick off and destroy curled leaves in fall and winter. When active stages appear, spray with nicotine sulfate and soap or with pyrethrum.

Chrysanthemum Thrips (*Thrips nigropilosus*)—Often serious on greenhouse chrysanthemum and sometimes outdoors. Young leaves are flecked whitish from loss of sap and there may be a gummy residue on the surface. If thrips are numerous foliage dies back.

Control. Pyrethrum sprays are apparently effective and so is nicotine sulfate and soap. In greenhouses fumigation for other problems will probably control this thrips.

Citrus Thrips (*Scirtothrips citri*)—An important citrus pest in the southwest. Sweet and mandarin oranges, lemon, lime, grapefruit, pomelo, kumquat are heavily infested; pomegranate, grape, pepper tree, umbrella tree, apricot are occasionally infested; and walnut, olive, willow, and almond are rarely infested.

The injury is a very definite ring scarred around the fruit at the blossom end, thrips-scarred fruit averaging 50 per cent in some districts. This is a pale yellow or orange species. Adults hibernate in trees or weeds in orchards, lay whitish eggs on young leaves in April and throughout the summer; there are several broods a year. Besides fruit scarring, there is often a withering and curling of leaves and blossom drop before fruit is set.

Control. Two or 3 applications of finely ground sulfur dust will control

citrus thrips. Tartar-emetic sprays, using 1 pound tartar emetic and 1 pound of sugar to 100 gallons of water, are used in high-pressure sprayers for this species.

Composite Thrips (*Microcephalothrips abdominalis*)—Frequently found on zinnias, marigolds, calendulas, and other flowers, but of relatively minor importance. The entire life cycle is passed in the flower heads. The adults are very small, dark brown. Greatest abundance is in fall when there may be some injury to flower seeds.

Dracaena Thrips (*Heliothrips dracaenae*)—Dusky yellow with abdomen shaded with brown, with netted head, thorax, and wings. It is present in California on dracaena, rubber tree, Kentia palm, sago palm, and century plant.

Figure 93

Rosebud blasted by thrips and opening flower with petal edges browned

Flower Thrips (*Frankliniella tritici*), or **Wheat Thrips**—Present in nearly every state; an omnivorous feeder on grasses, weeds, flowers, field, forage, and truck crops, deciduous and citrus fruit trees, berries, vines, and every other type of plant. It is, however, primarily an eastern species and its place in California is taken by another flower thrips (*Frankliniella moultoni*), also called grass thrips; and in Florida partly by the Florida flower thrips (*Frankliniella bispinosa*).

The adult flower thrips is amber yellow with a bright yellow or orange thorax, $\frac{1}{20}$ inch long. It is probably the most common thrips on roses in many gardens, ruining the June bloom. (Figure 93.) The buds turn brown at the edges and either ball (not opening at all), or else open to crippled, distorted blossoms with brown margins to the petals. Light-colored flowers are most often injured. The life cycle may be completed in 2 weeks, so there can be many generations; but on roses thrips injury is more likely with spring bloom than with the fall display,

Daylilies are also at times markedly injured by flower thrips, which gets in the buds and may cause entire flower clusters to wither. Thrips are almost always present on Japanese iris petals, but here there is less injury.

The **Florida Flower Thrips** has orange head and thorax, lemon-yellow abdomen, which is often curled over the back when disturbed. The larvae are similar but lack wings and are paler in color. This is a special pest of roses, the white-blossomed Spanish needle, and other flowers, and it feeds on strawberry blossoms so they either drop off or the young berries stay brown and hard. Abundant in the later blossoms, they shorten the bearing season. This species is also common in citrus and tomato blossoms, but is only occasionally injurious to the latter.

The **Western Flower Thrips** varies from clear lemon-yellow to dusky yellow-brown and is found on practically all types of plants. Wintering on weeds and attracted to tree blossoms in spring, the young larvae cause typical scarring and distortion of fruits. Flower thrips are more injurious to apricot, peach, plum, and nectarine blossoms in southern California than farther north where the blooming season is over before populations have been built up. They injure grapes in season, beans as they come through the ground, collecting on first leaves, causing stunting; also cucumber, cantaloupe, and squash vines suffering from lack of water; may be numerous enough to cause a blossom drop of peas, tomatoes, melons, sometimes strawberries. Cut flowers—roses, carnations, sweet peas, and gladiolus—are streaked by flower thrips, which is even more dangerous as a vector of the virus causing spotted wilt of tomatoes and other vegetables, gloxinia and many other ornamentals.

Eggs are laid in tender parts of plants—stems, buds, flowers; they hatch in 5 to 15 days; larvae feed on succulent portions for 7 to 12 days, molt once on the host, drop to the ground, pupate, molt once during this resting stage and, in cool climates, hibernate in protected spots. Peak of the seasonal infestation is in late spring. Adult flower thrips can be carried long distances by wind, but migrations are usually local.

Control. Remove sources of infestation, cover crops, and weeds, before host plants come into bloom. Spray with tartar emetic or other materials as outlined under gladiolus thrips. DDT is apparently helpful on roses.

Gladiolus Thrips (*Taeniothrips simplex*)—All too universally present in gardens. A relatively new insect, noticed first in 1929 in Ohio and Ontario, Canada, it has been rapidly distributed throughout North America. Though of chief importance on gladiolus it is also a pest of iris, including Spanish, Japanese, German, and bulbous types, and is known to feed and breed on amaryllis, narcissus, freesia, aster, delphinium, hollyhock. (Plate XXXI, page 294.)

Only 1/16 inch or less in length when full-grown, the gladiolus thrips is

still one of the larger species. Adults are black or brownish-black, with a creamy white band across the base of the wings. They insert, in growing plant tissues, kidney-shaped eggs which hatch in about a week to first-stage larvae, white with red eyes, which soon change to pale yellow second-stage larvae. The next stage is orange and is known as the prepupa; then the true pupal stage is formed—first orange, then light yellow, with white antennae, wing pads, and legs, red eyes—the black adult appearing in about 3 days. The complete life cycle takes from 2 to 4 weeks, depending on the temperature, the effective range being from 50 to 90° F. There are several generations in the outdoor garden and breeding may continue on corms in storage. Except in warm climates thrips do not overwinter in the ground, as they are killed by low temperatures.

Injury to gladiolus shows as a silvery appearance to the foliage, due to the many small areas where cell sap has been lost, followed by browning and dying of leaves. Flowers are deformed, with whitish flecks or streaks, spikes may not open. Corms in storage become sticky, corky, russeted, and either fail to germinate when planted or produce poor flowers or none.

Control. Corm treatments and summer spraying are both necessary for effective control once a garden is infested. The simplest corm treatment is fumigation with naphthalene flakes. After harvest the corms are placed in paper bags, and 1 ounce of flakes added for each 100 corms; the bags are closed tightly, shaken to distribute the flakes, and then stored for 3 to 4 weeks, if the temperature is around 50° F.—less time for a warmer storage place. The bags are then opened, any excess flakes screened off, the corms aired and stored as usual. Some gardeners report excellent results from shaking a small amount of rotenone dust over the corms and storing in a closed container until spring.

As an added precaution corms can be treated just before planting, either by soaking 2 to 3 hours in bichloride of mercury, 1 to 1,000 dilution; or for 3 hours in Lysol, using 1½ tablespoons to 1 gallon of water.

Summer spraying starts when the plants are 8 to 10 inches high, and is repeated weekly as a general precaution, or at more frequent intervals if the infestation becomes serious. For each gallon of water use 2 teaspoons tartar emetic and 4 teaspoons brown sugar; or 2½ tablespoons Salp (sodium antimony lactophenolate) plus 4 teaspoons brown sugar, and a little flour, or 1 tablespoon corn syrup; or 2 teaspoons nicotine sulfate plus brown sugar or corn syrup. Tartar emetic is considered somewhat more efficient at temperatures below 60° F., and Salp possibly more efficient in hot weather. Either chemical is neutralized by the presence of other materials, so it is essential to clean the sprayer well before and after use.

Spraying is best done on a cloudy day, or around ten in the morning

or four in the afternoon, when the maximum number of larvae are on the surface feeding. Ordinarily they hide between the leaf sheaths and in the petals, and are very difficult to reach with a spray.

Grape Thrips (*Drepanothrips reuteri*)—A relatively recent pest of grapes in California. It looks much like the flower thrips but continues to reproduce on the vines, causing burning and curling of young leaves and scarring of berries.

Control. Dust with pyrethrum or nicotine dust, starting when berries are setting.

Grass Thrips (*Anaphothrips obscurus*)—Sometimes abundant on grains, grasses, occasionally on corn, destroying softer part of foliage, flowers, and developing kernels.

Control. Destroy old stems and litter where insects hibernate.

Greenhouse Thrips (*Heliothrips haemorrhoidalis*)—Practically worldwide. It is present out-of-doors in California, Florida, Georgia, and probably other southern states, and in greenhouses nearly everywhere. Outdoor plants often injured include avocado, azalea, cacao, citron, guava, lime, mango, orange, persimmon, coffee, croton, laurestinus, pinks, rhododendron, toyon, viburnum. In greenhouses there is often serious injury to amaryllis, begonia, chrysanthemum, citrus plants, croton, cyclamen, dahlia, ferns, fuchsia, gloxinia, nasturtium, orchids, palm, rubber plant, syngonium, and others.

The greenhouse thrips is distinguished by a deep network of lines over head and central portion of the body, which is blackish-brown, with the posterior end lighter; 1/24 inch long, legs yellow, wings slightly clouded but without bands, antennae slender and needle-like at tip. Feeding is almost entirely on foliage and fruits, and more often on inner parts of trees and shrubs in concentrated colonies with all stages present at the same time. Plant tissues quickly look silvery or bleached, leaves papery, wilting, dying, sometimes dropping off. Foliage and fruit are spotted with reddish-brown dots of excrement.

Control. This species is quite readily controlled with sprays or dusts of pyrethrum, or nicotine and oil, with a second treatment about 10 days after the first. Calcium-cyanide fumigation in greenhouses is also satisfactory.

Hollyhock Thrips (*Liriothrips varicornis*)—Apparently limited to a semi-arid climate. It is found in California, principally on hollyhock, and looks like the Christmasberry thrips; brilliant red and black larvae, all-black adults. Colonies feed in depressions in leaves, stems, stalks, and roots.

Control. Heavy watering of soil around base of infested plants and destruction of all old stalks and volunteer plants during fall and winter are sufficient deterrent to this not too serious pest.

Iris Thrips (*Bregmatothrips iridis*)—Often abundantly infesting Japanese iris. The larvae are at first white, later yellow. They rasp folds of inner leaves, cause a russeting and soot-like blackening of foliage, stunting of growth; tops die and turn brown.

Control. Spray with nicotine sulfate and soap, applying forcibly into leaf bases; or try a rotenone-oil spray.

Lily Bulb Thrips (*Liriothrips vaneecki*)—Confined to lily and orchids; known in New York, North Carolina, California, Oregon, and Washington. This thrips, shiny black, 1/16 inch long, with salmon-pink and black larvae and pupae, spends its entire life on bulbs, feeding on epidermis of outer scales near base. Injured areas tend to turn rusty brown and be sunken or flabby, but there is no great damage.

Control. When necessary, which is seldom, bulbs can be fumigated with paradichlorobenzene crystals for 96 hours, using 3 ounces to a cubic foot of space.

Madrona Thrips (*Thrips madroni*)—Pale yellow to dark brown. It occurs in Oregon and California on ceanothus, madroña, azalea, elderberry, rhododendron.

Onion Thrips (*Thrips tabaci*)—Probably the most widely distributed thrips in the world, and found in all onion-growing sections of this country. It attacks nearly all garden plants and many weeds and field crops—up to several hundred food plants. Many of these are incidental, with little breeding on them, but aside from onions some of the most important vegetable hosts are: bean, beet, carrot, cabbage, cauliflower, celery, cucumber, melons, peas, squash, tomato, and turnip. Injury to onions shows first as whitish blotches, then blasting and distortion of leaf tips, followed by withering, browning, and falling over on the ground. The bulbs are distorted and undersized. Thrips congregate in greatest numbers between leaf sheaths and stem, and carry over on the bulbs in storage. On peas, cucumbers, and melons injury often shows as crinkled, curled, or dwarfed leaves.

Ornamentals infested by onion thrips include asparagus fern, campanula, carnation, chrysanthemum, dahlia, gaillardia, gloxinia, mignonette, Jerusalem cherry, rose, and sweet pea. Roses, carnations, and other flowers are injured by a spotting and streaking of petals. Like the flower thrips, onion thrips transmits the virus of spotted wilt disease to tomatoes, sweet peas, and many ornamentals.

The onion thrips is variable in color, ranging from pale yellow to dark brown, about 1/25 inch long. Wings are a uniform dusky-gray without bands; larvae are creamy-white; pupation is in soil. Eggs are laid in surface tissue of hosts, and in summer hatch in about 5 days. The first molt of larvae is on plants, the second in soil. A generation is completed in a

little over 2 weeks, and in mild climates, like California, continues the entire year. Winter hosts are weeds or bulbs in storage.

Control. It has been difficult to control onion thrips because they are so well hidden from sprays, although pyrethrum and nicotine sprays are fairly effective on young plants. Tartar-emetic sprays are probably most satisfactory, using a 2—4—100 formula (2 pounds tartar emetic, 4 pounds brown sugar to 100 gallons water). In small quantities this is about 2 teaspoons tartar emetic and 4 teaspoons brown sugar per gallon. Salp may be substituted. Another onion treatment is the application of a mixture of 4 parts by weight of crude chipped naphthalene and 6 parts hydrated lime along the row.

For ornamentals use tartar emetic, Salp or pyrethrum, or nicotine sprays.

Pear Thrips (*Taeniothrips inconsequens*)—Present along the Atlantic coast in New York, Pennsylvania, and Maryland and on the West coast in Washington, Oregon, and California, where it causes severe injury. This is an imported species, first noted in California in 1904. Besides pear it attacks apple, apricot, cherry, grape, peach, plum, prune, and several other fruits as well as poplar, maple, willow, madroña, California laurel, and various weeds and grasses around orchards. There are two types of injury: first, a bleeding and gumming of pear buds, blackening of prune buds, with lack of bloom most serious in a delayed spring when buds open slowly; second, as the fruit buds develop adults insert so many eggs in stems that they weaken, blossoms wither and drop. After full bloom the larvae hatch and feed under husks of young fruit, causing scarring, distortion, and scorching unfolding leaves with ragged margins.

The pear thrips is uniformly dark brown, slender, bluntly pointed at each end, 1/25 inch long, with grayish wings lighter at the base. Larvae are white with dark red eyes.

Control. Rotenone or tartar-emetic sprays give good control of larvae and should be applied at the first calyx spray.

Privet Thrips (*Dendrothrips ornatus*)—An eastern species very injurious to privet in some seasons. In 1945 privet hedges in states along the middle Atlantic coast were uniformly gray from the sucking of this species, dark with a bright band, which seemed to interfere with new growth as well as sucking sap out of older leaves.

Control. Test spraying in several gardens in 1945 convinced me that privet thrips is readily killed by any contact insecticide, since it is exposed and not hidden. Nicotine sulfate and soap, tartar emetic and sugar, Salp and sugar, and Triogen were all satisfactory. Once the rapid breeding was halted new growth came out normally. Sharp pruning back, plus spraying, quickly returns a hedge to ornamental status.

TOADS

Toads are tailless amphibians which commonly live on land, although their eggs are laid in water. They have stout, puffy bodies and warty-looking skin, but it is not scaly like the reptiles (snakes and lizards). They take about 5 years to mature and are very definitely garden friends, eating countless numbers of insects, snails, slugs, and worms. Since they are cold-blooded they may, like fish, succumb to rotenone sprays or dusts, so let the toads hop out of the way before spraying. They do not cause warts.

TREEHOPPERS

Treehoppers are closely related to leafhoppers, belonging to the order Homoptera, sucking insects with the same type of wings; and to the family Membracidae, which is characterized by having a pronotum (taking the place of the thorax in other insects) greatly enlarged and sometimes grotesquely developed into knobs or horns. Many treehoppers are tropical, but there are some agile species on trees, shrubs, and herbaceous plants in this country.

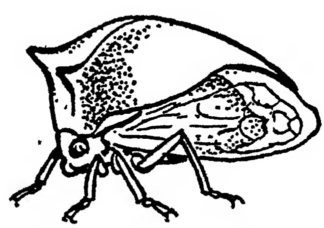


Figure 94

Buffalo treehopper, side view

Buffalo Treehopper (*Cerasa bubalus*)—Found almost everywhere in the United States except perhaps the far South. The injury to fruit trees (apple, pear, peach, quince, cherry), elm, locust, cottonwood, and other trees comes from the punctures made by the female in oviposition (egg-laying) in bark of small branches and twigs. These are double rows of curved slits inside which 6 to 12 elongated yellowish eggs are embedded in the inner bark. Infested trees look rough, scaly, or cracked and seldom make a vigorous growth. The wounds also offer entrance to disease organisms.

The eggs winter in the wood, hatching in late spring into pale green spiny nymphs which drop from the tree and feed on sap of various weeds and grasses until August when they become adult, triangular-shaped, light

green insects, blunt at the head end with a short horn at each upper corner, pointed at the rear, and 1/4 inch long. (Figure 94.) The female has a knife-like ovipositor to cut the slits in twigs for her egg-laying.

Control. Keeping down weeds helps somewhat in control. A dormant oil-emulsion spray kills many overwintering eggs.

Two-marked Treehopper (*Echenopa binotata*)—Frequently found on butternut, sometimes on locust, bittersweet, sycamore, hickory, willow, wild grape, redbud, and hoptree. This small treehopper looks much like a bird in side view, with a high curved horn projecting forward from the thorax. It is dusky brown with two lemon-yellow spots on the back. The female lays eggs in butternut buds and in twigs just below the buds. These are uncovered, but she also lays eggs in bark of locust, bittersweet, and hoptree, and these she covers with a frothy, waxy material in corrugated layers. Eggs are laid in August and September, hatch the following May into small, white, powdery nymphs which mature in late June and July into very active adults.

Butternut buds are often destroyed in the egg-laying, and leaves punctured. Grape stems and bittersweet vines may be noticeably injured.

Control. There is no very satisfactory method. Probably nymphs can be killed by a nicotine-sulfate spray in late May.

Twig Girdlers—See under **Borers.**

WALKINGSTICKS

Walkingsticks belong to the grasshopper order, Orthoptera, and to the family Phasmatidae, a remarkable group of insects which so closely resemble their environment, twig, or leaf, that they go unnoticed until they move. They lack wings, their long legs are fitted for walking, the thorax is greatly elongated, and they are plant-feeders. Except in southern states only one species is generally abundant.

Walkingstick (*Diapheromera femorata*), also known as **Northern Walkingstick**—The common species found from New England to the Rocky Mountains. It prefers oak and wild cherry, but feeds also on hickory, locust, and other trees, even on roses and various shrubs.

The insect has a long, slender body, green or gray-brown, long legs, and long and hair-like antennae. It looks almost exactly like the twig it rests on. It is about 3 inches long, moves slowly, awkwardly. The eggs are dark, bean-shaped, and dropped anywhere on the ground, where they lie among leaves until the next, or even the second, spring. Light green nymphs mature in about 6 weeks, meanwhile feeding ravenously on foliage. There is only one generation.

Control. If the walkingsticks are numerous enough to warrant the expense, spray with lead arsenate.

WASPS

Wasps cannot really be classed as pests in the garden. The few harmful species are many, many times outweighed by the parasitic wasps which do so much to keep insects within bounds. Braconid, chalcid, ichneumon, and egg-parasite wasps are the ones most useful to gardeners. A few harmful gall wasps have been mentioned under galls. In the family Vespidae, which includes paper wasps, hornets, and yellow jackets, we have the vespa hornet, one of the social wasps which is injurious to lilacs, and the cicada killer, a solitary digger wasp sometimes injurious to lawns.

Like bees and sawflies, wasps belong to the order Hymenoptera, which means "married wings," characterized by 2 pairs of membranous wings hooked together. The abdomen is joined to the thorax with a slender waist; the female has a definite ovipositor which acts as a stinger as well as for egg-laying; the mouth parts are adapted for chewing and lapping and there is complete metamorphosis.

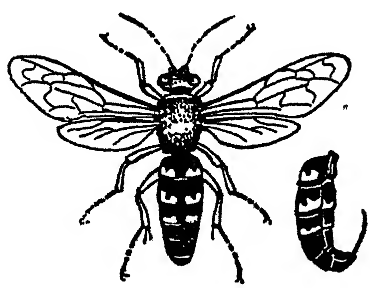


Figure 95

Cicada killer or digger wasp, with side view of abdomen showing stinger or ovipositor

Cicada Killer (*Sphecius speciosus*)—A large wasp, nearly 1¼ inches long, black with abdomen banded with yellow and a wicked-looking ovipositor or stinger on the female. (Figure 95.) Adults appear in late summer, dig their burrows in soil, often in lawns, sometimes in sandy walks, banks, or terraces. Sloping tunnels go far underground, up to 18 inches, and terminate in a globular cell, often with other lateral cells. After making her burrow, the wasp goes to look for a cicada in a tree. She darts at it and they both fall to the ground. The wasp stings the cicada to paralyze it and, then. straddling her bulky prey, she crawls up a tree to

a good launching point to take flight toward her burrow. If she does not make it the first time she crawls up another tree. Arrived at the opening, she drags in the cicada, stores it in a cell, and lays an egg between its legs. Each cell is provided with 1 or 2 cicadas, sealed off before the next cell is filled. The egg hatches in 2 or 3 days, and the larva feeds by sucking out the cicada contents for about 2 weeks, then makes a cocoon of silk, resting in it until the next summer, when it pupates and produces the adult.

I have seen lawns almost entirely covered with holes and piles of earth, and I have seen the wasps so numerous around a public library that the public stayed away and even the postman was afraid to deliver mail. In such cases control measures are really necessary.

Control. Inject carbon bisulfide from a machine-oil can into the holes, plugging the opening with earth. Caution: this chemical is highly inflammable! Make a wire bat, something on the order of a tennis racket but with a longer handle, and whack the wasps when they get numerous enough to be frightening. This is not so dangerous a pastime as it sounds because the big wasps are readily stunned. I have never yet been stung by one, though I have killed them by the dozen. However, just one sting would give a pretty sizable reaction, and it is well to have a bottle of spirits of ammonia on hand. In fact, I try to keep one with me always when working in gardens. Apply a few drops immediately to any bee or yellow-jacket sting and you usually avoid painful aftermaths. If swelling develops, try a moist compress of Epsom salts.

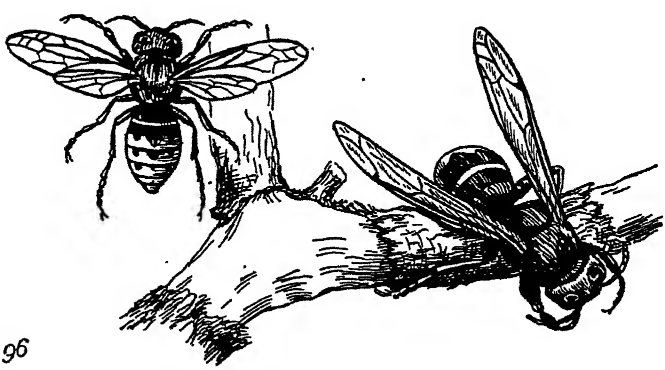


Figure 96

Giant hornet, natural size and slightly enlarged, tearing bark from lilac stem for nest

Giant Hornet (*Vespa crabro*), also known as **European Hornet** or **Vespa Hornet**—It looks something like the digger wasp but is somewhat shorter, stouter fuzzier. (Figure 96.) It is the largest hornet in this country,

1 inch long, black with orange markings on the abdomen. Injury comes from its habit of actually gnawing the bark, preferably of lilacs, sometimes willow, poplar, or other shrubs and trees, to make a nest which may be in a tree cavity, an opening in a building, or underground. It girdles twig and branches up to an inch in diameter, which look exactly as if squirrels or mice had been working. The results are most disfiguring to ornamental shrubs, and of course branches entirely girdled die back.

Control. Some recommend trying to find the nest and puffing in some calcium cyanide dust (Cyanogas) or squirting in carbon bisulfide, but I never seem to find the nests. Others recommend coating the branches with bordeaux mixture plus arsenate of lead, but I think this leaves the shrubs something less than ornamental. I follow the painless method of spraying trunks and branches with one of the special derris sprays sold for Japanese beetles (Jap-Ro-Cide or Japellent), making it up double or triple strength. This is not disfiguring and seems very effective.

Parasitic Wasps

Braconid Wasps—A major group of insect parasites which very definitely check the increase of important plant pests. Many braconids are parasites of lepidopterous larvae (caterpillars); some are beetle parasites.

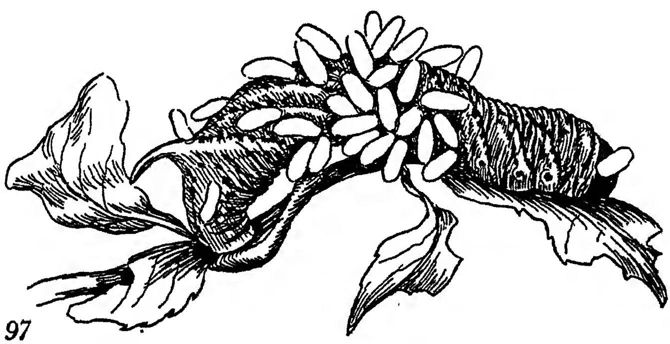


Figure 97

Tomato hornworm parasitized by a braconid wasp. The white egglike objects are cocoons

They can be external parasites, attacking half-grown larvae in cells, leaf-roll webs, or other covering, or internal parasites, with the female depositing her eggs inside the host insect; or they can be egg parasites with the female laying her eggs inside the egg of the host insect.

Tomato hornworms or catalpa sphinx caterpillars covered with tiny white cocoons which look like eggs have been parasitized by braconid

wasps. (Figure 97.) Stiff dead aphids with holes in their backs have been parasitized by braconid wasps. (See Figure 20, under Aphids.)

Chalcid Wasps, sometimes called **Chalcid Flies**—Most species are parasites and beneficial although some feed on plants. The fig wasp is a chalcid wasp, imported here to fertilize Smyrna figs. Pollination is dependent on this particular wasp, which in turn cannot live without the figs.

Chalcid wasps live in the bodies or eggs of scale insects, aphids, caterpillars, and flies. They occur in great numbers, more than 3,000 individuals having been reared from a single cabbage worm. Unfortunately some chalcid wasps are hyperparasites, living on other beneficial insects and so are our enemies.

Egg parasites are some of the smallest known insects, growing to maturity inside a single insect egg. They are mostly slender, non-metallic, with an ovipositor attached to the tip of the abdomen. One of the most useful is the chinch bug egg parasite; other species live in the eggs of moths, bugs, grasshoppers, spiders, flies, including the Hessian fly.

Ichneumon Wasps—This family includes some very large and some very small parasitic wasps. The most peculiar is the long-sting with a body 1½ inches long and a tail-like ovipositor nearly 3 inches long. It thrusts this long stinger into wood until it reaches the burrow of a wood borer, the larva of the pigeon tremex. On hatching, the wasp crawls along the burrow until it reaches the larva. Most ichneumon wasps attack caterpillars and are extremely helpful.

WEBWORMS

Webworms are merely caterpillars which feed protected by webs. Some, like the tent caterpillar, have been treated elsewhere; those commonly known as webworms are discussed here.

Alfalfa Webworm (*Loxostege commixtalis*)—The larvae are greenish-yellow caterpillars with a light stripe down the back; adults are buff-colored moths, irregularly marked with light and dark gray, and with a row of spots on underside of hind wings, spreading to 1 or 1¼ inches. Food habits and control are the same as for the Beet Webworm, which see.

Barberry Webworm (*Omphalocera dentosa*)—Black, white-spotted caterpillar, 1½ inches long, makes webs on twigs and devours leaves of common and Japanese barberry in late summer and fall. Webby, frass-filled masses remain over end of shoots during winter.

Control. Spray in summer with lead arsenate.

Beet Webworm (*Loxostege sticticalis*)—Occurring from the Mississippi Valley west to the Continental Divide. This small webbing cater-

pillar, together with the alfalfa webworm, is a very general and destructive feeder on cabbage, beet, sugar beet, bean, pea, potato, spinach, cucurbits as well as other vegetables, and alfalfa and field crops. These webworms are economically important, causing thousands of sugar-beet fields to be abandoned, destroying fields of alfalfa, yearly taking a large share of truck crops. They work like armyworms, cleaning up one field, then moving en masse to the next.

Larvae are yellow or green to nearly black, with a black stripe down the middle of the back and 3 small black dots bearing bristles at the side of each segment. As they skeletonize and devour leaves they draw them together with a web and make a tube, perhaps several inches long, to a hiding place under a clod of earth or other protected area. They pupate, for 2 to 3 weeks, in a cell an inch or two underground. The adult, a night-flying moth, is smoky brown with dusky and straw-colored spots and lines, and a continuous dark line near margin of the hind wings. The female lays white, yellow, or green oval eggs in a single row on underside of leaves. There may be three partial generations.

Control. Spray or dust vegetables with rotenone after edible parts are formed.

Cabbage Webworm (*Hellula undalis*)—An imported species distributed through the states. The caterpillars, grayish-yellow with purple stripes and about ½ inch long, feed under webbing on inner leaves, hearts, stalks of cabbage, cauliflower, kale, sometimes on beets, collards, horse-radish, radish. The moths are grayish, mottled with brown.

Control. Spray or dust with rotenone, starting early before webs are formed.

Corn Root Webworm (*Crambus caliginosellus*)—One of the sod webworms. The caterpillar is whitish, a little over ½ inch long; the moth is straw-colored with indistinct markings, one of the snout moths with a short projection from the head. When one stirs them up in walking over grass they move in jerky flights and rest with wings so tightly folded around the body that they look like tubes. Eggs are laid in summer; the young larvae feed a little, then hibernate in nests in grass and sodland, becoming active in spring. They destroy roots and work from the crown into the cornstalks, injuring developing leaves, like budworms, and often chew the stalks at the surface of the ground like cutworms. Full-grown in July and August, they pupate underground in a silken cocoon.

Control. Do not plant corn in land recently taken over from sod. If young corn shows injury dig it up and plant a substitute crop.

Cotoneaster Webworm (*Cremona cotoneaster*)—First noted in Oregon in 1929, present also in Washington. Yellowish larvae, turning dark when grown, make silken tubes from a larger silken refuge at the base

of branch junctions. They skeletonize leaves and make unsightly webs. They winter in the refuge base and pupate there in spring, producing grayish-black, night-active moths. Small plants die, others are weakened.

Control. Use rotenone or lead-arsenate spray or dust.

Fall Webworm (*Hyphantria cunea*)—Widely distributed. At least 120 varieties of fruit, shade, and woodland trees serve as food plants, popular hosts being apple, cherry, peach, pecan, English walnut, black walnut, ash, boxelder, birch, chokecherry, elm, hickory, linden, poplar, sycamore, white oak, and willow. Roses and other shrubs are sometimes webbed. The webworm acts much like the tent caterpillar, but it makes its nest over the end of branches rather than in tree crotches.

Cocoons enclosing brown pupae under trash on ground or under tree bark carry the fall webworm over winter. Satiny white moths, often marked with brown spots, wing spreading 1¼ to 1¾ inches, emerge over a long period in the spring. The females lay greenish eggs in masses of 200 to 500, often covered with a woolly layer of scales. The caterpillars are pale green or yellow with a dark stripe down the back and a yellow stripe along each side. The body is covered with very long silky gray hairs arising from black and yellow tubercles. When full-grown, about an inch long, after 4 to 6 weeks of feeding, they crawl down the trees to form cocoons. There are really two forms: one, in the far northern states, has only one generation, the other form, the typical one, has two broods, the first feeding in late May or June, the second, and more destructive brood, feeding during July, August, and September.

The larvae spin a layer of silk over the surface of a leaf as soon as they start feeding, eventually webbing together the ends of several branches, always very unsightly and often defoliating one limb, sometimes nearly all the tree or shrub.

Control. Summer sprays for codling moth will prevent webworm damage on apples. On shade trees and other ornamentals it is usually possible to cut off the webbed ends of branches and to burn the nests without resorting to spraying, if this is done as soon as webs are first seen. One thorough spraying with lead arsenate before there is much webbing will give control. There are several natural enemies—egg parasites and others.

Garden Webworm (*Loxostege similalis*)—Distributed over much of the United States but more of a pest in the Middle West and Southwest. This webworm is much like alfalfa and beet webworms, attacking alfalfa, clover, and field crops but also working on garden vegetables such as beans, soybeans, cowpeas, beets, and on strawberries. The hairy caterpillars are dark yellow or pale green with many pale spots. They spin webs wherever they go, and also make silken tubes for shelter on the ground. The adult moth, with light and dark markings, is about an inch across the wings. In

Texas there are as many as five generations and there are two or three even in the North.

Control. Dust or spray vegetables with rotenone. Use lead arsenate on other plants.

Juniper Webworm (*Dichomeris marginellus*)—A European species first recorded here in 1910, present in Connecticut, New York, New Jersey, Maryland, California, and probably other states. In some places it is the most important pest of *Juniperus communis* and may damage other varieties, especially *J. depressa, hibernica,* and *suecica.*

The winter is passed as partly grown larvae in silken cases in webbed foliage. They are light brown, with a reddish-brown stripe down the back, 2 wider dark brown stripes along the side with short white hairs over the body. They resume feeding in spring, being ½ inch long when full-grown, pupate in May with adults usually emerging in June. The moths have brown fore wings with white margins, and gray, fringed hind wings. They are only ⅗ inch across and lay eggs in leaf axils of new terminal growth. There is one generation a year, the larvae being only half grown before hibernation. The needles are webbed together with silk enclosing frass, turn brown, and die. Sometimes the whole top of a small juniper is webbed and massed together.

Control. Where possible cut out webbed masses. Spray with lead arsenate in July when larvae are young and before webs are thick. In spring a strong pyrethrum spray will sometimes kill larvae in the webs.

Parsnip Webworm (*Depressaria heracliana*)—Present on parsnip, celery, and related weeds in northern states east of the Mississippi. Flower heads are webbed together and eaten by small, yellow, green, or grayish caterpillars covered with small black spots and short hairs. They interfere with seed production and may mine in stems. The moth is gray, winters under loose bark, lays eggs in spring on developing flowers. Caterpillars pupate in mines in stems, moths coming out in late summer.

Control. Cut and burn infested heads before moths emerge.

Pine Webworms or **Pyralids** (*Tetralopha robustella* and *T. melanogrammos*)—These 2 species work near the ends of terminal pine twigs, producing quantities of brown frass in a silken web. Caterpillars are brown or tan with a black stripe along sides of the body, an inch long or just under. Moths have dark brown fore wings with a transverse gray band, dark, ashy hind wings, spreading to 1 inch. When they mature they go into the ground and spin flimsy cocoons for the winter.

Control. Applied early enough, lead-arsenate spray is an efficient control. Most gardeners, however, do not notice the caterpillars until the webbing is conspicuous (June in New Jersey) and most of the chewing is over.

Sod Webworms (*Crambus* spp.), or **Lawn Moths**—Small moth millers which fly up when you walk across the grass. There are many species that damage lawns in different parts of the country, but they seem to be more abundant in mild climates and are usually restricted to blue or bent grass. In California 2 species regularly give trouble. *Crambus bonifatellus* prefers moist lowlands; the moth is creamy buff with small white, brown, or black spots; the black-spotted larva is gray, slender, with a brown head. *Crambus sperryellus* prefers drier land; the moth has golden fore wings streaked with silver; the larva has dark spots on head and body but is a lighter gray, about 3/4 inch long. The moths fly slowly over lawns at dusk, dropping eggs anywhere over the grass. Young larvae skeletonize grass blades but older caterpillars cut them off completely. They make tubes or little tunnels, silken shelters camouflaged with bits of grass and bright green excrement. Pupation is in loosely woven cocoons just below the surface of the ground. There may be several overlapping generations.

In the East the predominant species is the vagabond or black-headed sod webworm (*Crambus vulgivagellus*), normally a grass-feeder but sometimes attacking corn. The bluegrass sod webworm (*C. teterellus*) is more at home in Kentucky and other points south of the Ohio and east of the Mississippi River. It is often accompanied by the striped sod webworm and the leather-colored sod webworm.

Control. The most long-lasting treatment seems to be lead arsenate applied with a sprinkling can at the rate of 5 pounds in 50 gallons of water over 1,000 square feet. An easier method, and probably almost as effective, is to dust on dry lead arsenate with a dust gun, using 6 or 7 pounds per 1,000 square feet, working it into the ground with a broom, and then washing it in with a strong stream of water from the hose. Pyrethrum sprays and also dichlorethyl ether give temporary control, but must be repeated 2 or 3 times a season. Kerosene emulsion is an old remedy, but it is apt to injure lawns and must be prepared with great exactness.

Small Beet Webworm (*Hymenia fasciālis*), also called **Hawaiian Beet Webworm**—Common in Florida and other states of the far South. The larvae live chiefly in weeds, and moths collect about blossoms of catnip, with beet a minor host.

Spotted Beet Webworm (*Hymenia perspectalis*)—The larva is a small green caterpillar with purple dots on its head; the moth is cinnamon-brown with narrow white bands in middle of fore wings. Eggs are laid on leaves of beet and amaranth.

Control. Both beet species can be controlled with arsenical dusts, where foliage is not to be used for greens, or with a safer pyrethrum-sulfur dust.

WEEVILS

A weevil is a beetle with the head prolonged into a beak or snout, with the mouth parts at the end. Practically all weevils are injurious plant-feeders, both as larvae and as adults. Weevils infesting fruits and nuts are often called curculios and have been treated under that heading.

Apple Flea Weevil (*Rhynchaenus pallicornis*)—Found from Missouri and Illinois east to New York, but more destructive in the western portion of its range. It riddles with tiny shot holes the leaves of apple, haw, winged elm, hazelnut, quince, wild crab, blackberry. The adult winters in trash or grass under apple trees. It is a very small (1/10 inch long) black snout beetle, puncturing first newly opening leaves and buds, then laying eggs along leaf midribs. The grubs mine between upper and lower surfaces, pupate in a cell inside the leaf, emerge as beetles in late May and June. They feed for 2 weeks on foliage, giving the summer shot-hole effect, then go into hibernation in trash.

Control. If the regular apple-spray schedule does not control this pest try cryolite or barium fluosilicate for the pre-pink and pink stages, using 5 pounds cryolite and 8 pounds wettable sulfur to 100 gallons.

Bean Weevil (*Acanthoscelides obtectus*)—Probably a native American, although found around the world. Beans stored for seed or food are almost certain to be devoured by weevils unless precautions are taken. The bean weevil is a small snout beetle, 1/8 inch long, olive-brown mottled with darker brown and gray, with reddish legs and antennae. Escaping from stored beans to the garden, it feeds on beans until pods are formed, then lays eggs in holes chewed along the pod seam. Small hairy white grubs, produced in 3 to 30 days, enter and feed in young seed. (Plate XXXVII, page 392.)

If the storage room is warm there may be many generations during the winter. The grubs, after molting once to a legless, humpbacked form and feeding for 2 to 6 weeks (depending on the temperature and moisture content of the seed), pupate in cells inside the bean. The weevils then emerge through tunnels and eat their way out through the seed coat, leaving conspicuous holes.

Control. Fumigation by carbon bisulfide or a safer mixture of propylene dichloride and carbon tetrachloride is a control best left to the farmer or commercial seed grower, but here is a way to use carbon bisulfide if you want to:

First make sure that no lighted cigarettes or other sparks come near. Use a garbage can or similar container out-of-doors. Put in the seeds, spread out in a shallow pan in the can, cover them with cloth and over

the cloth pour 1 teaspoon carbon bisulfide for each gallon of capacity of the can. Cover, seal the edges with Scotch tape, and let stand 24 to 36 hours. Choose weather when the temperature is about 70° F. Let the seeds air out before storing.

If you are saving small quantities of seed a simpler method is to add half as much lime as seeds, shake together and store in a tight container. Such seeds are safe for food if washed thoroughly before use. Another method is to dip the beans for 1 minute in boiling water, drying carefully before storing. Or seed may be spread out in pans and heated for 1 hour in a slow oven held at 130 to 135° F. Some say it takes 3 to 4 hours to kill all the weevils.

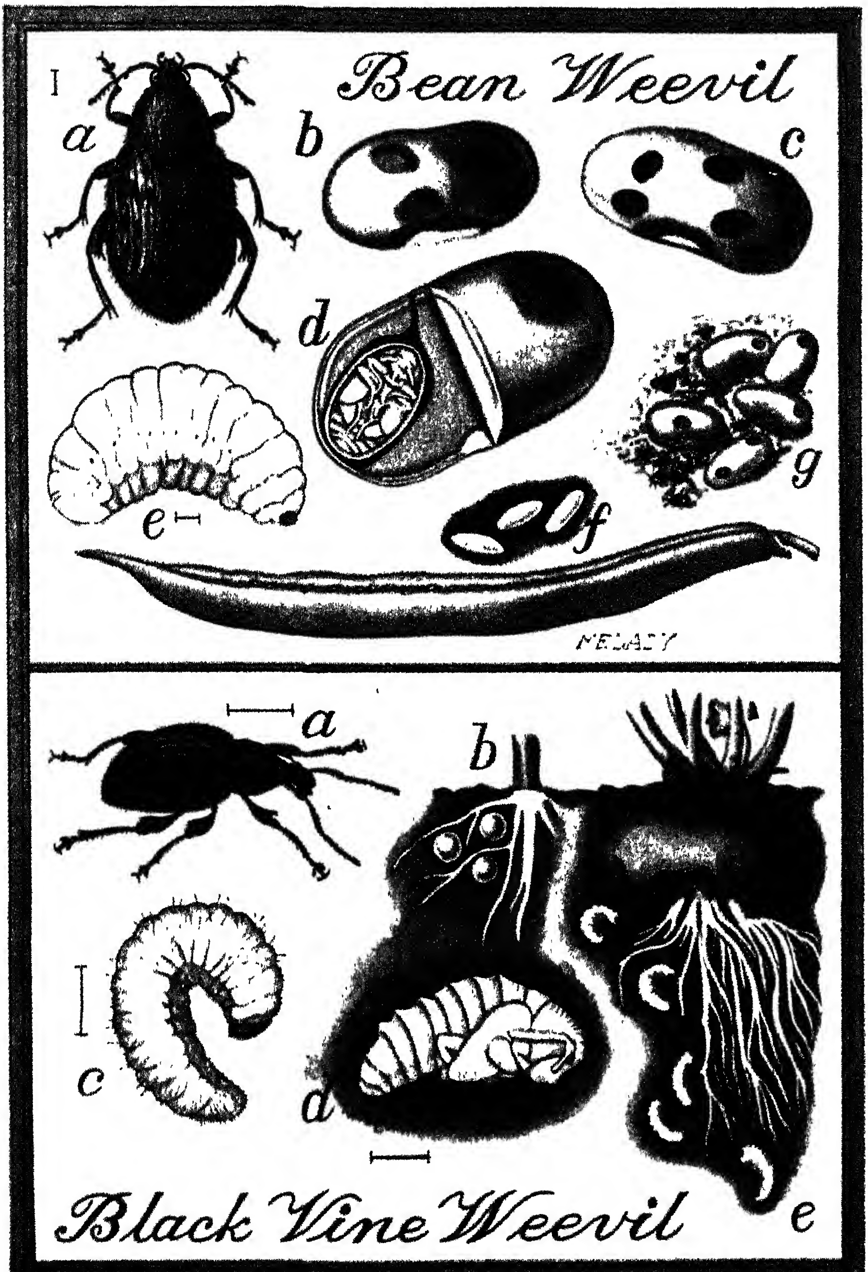
Dusting growing beans with rotenone will reduce weevil infestation in the garden. Under no circumstances should you plant untreated infested seed. Do not leave any crop remains on the ground after harvest. Pick and shell beans early and burn all debris.

Black Vine Weevil (*Brachyrhinus sulcatus*), or **Cyclamen Grub**—A European species now widely distributed here. (Plate XXXVII, page 392.) It is one of the few really serious pests of taxus or yew, attacks a number of other garden shrubs, some flowers, and is a greenhouse menace. The grubs feed on roots, the adults chew foliage at night. The host list includes ampelopsis, azalea, begonia, blackberry, cranberry, cyclamen, gloxinia, geranium, gardenia, maidenhair fern, primrose, raspberry, rhododendron, retinospora, spirea, strawberry, wisteria.

The adult is a small weevil, ⅜ inch long, with a very short snout, black or brownish in color with very fine yellow hairs, and a sort of corrugated effect down its hard, wingless body. Larvae are small, whitish, curved grubs which remain in soil feeding on small roots, often destroying them entirely. Hibernation is usually as partly grown larvae, sometimes as adults in soil. After feeding on roots during April and May (New York calendar), larvae turn into soft white pupae, emerging as weevils in June. They hide in the soil during the day, feed on foliage at night.

Specimens of yew newly transplanted from nurseries to the garden are particularly subject to injury from black vine beetle grubs. Small roots are eaten off, larger roots are girdled. If, in a yew hedge, certain plants do not start into new growth at the normal time in spring, if the tops turn yellow, and then brown, the black vine weevil is probably to blame and prompt measures must be taken.

On rhododendrons, nocturnal feeding leaves large irregular holes eaten in from leaf margins. On strawberries a related species, the strawberry root weevil, is somewhat more injurious than the vine weevil. In greenhouses larvae continue to feed during the winter months, causing stunting, wilting, death of cyclamen, primrose, and other plants. Adults appear earlier in spring than out-of-doors and lay eggs over a longer period.



XXXVII **BEAN WEEVIL: (a)** adult weevil or beetle; **(b)** bean with blemishes indicating weevils inside; **(c)** bean showing exit holes; **(d)** bean cut to show pupa in position; **(e)** grub (larva) (much enlarged); **(f)** eggs (magnified), and in position on bean pod; **(g)** remains of a weevil-infested bag of seeds: empty beans, powdery frass left by larvae, dead adult weevils. **BLACK VINE WEEVIL: (a)** adult; **(b)** eggs among roots in soil; **(c)** grub (enlarged); **(d)** pupa in earthen cell below soil surface; **(e)** grubs (larvae) in soil and typical injury to cyclamen corm and feeding roots.

XXXVIII **PICKLEWORM:** **(a)** adult moth with characteristic scaly brush at end of abdomen; **(b)** melon shoot showing feeding injury and stem cut to show young larva; **(c)** squash fruit with entrance holes; **(d)** eggs laid at base of bud; **(e)** full-grown larva. **MELON WORM:** **(a)** squash vine with feeding holes, pupa in folded leaf, adult moth, and young larvae on foliage; **(b)** adult moth; **(c)** full-grown larva.

Control. Since grubs or adults may enter gardens in soil around balled plants, a close watch should be maintained over newly transplanted evergreens and the soil examined for grubs or weevils at the first sign of ill health. The wingless adults do not migrate very far but they will crawl to near-by established shrubs. Soil under bushes can be treated with lead arsenate, using 1 to 3 pounds worked into 100 square feet. An apple bait, with sodium fluosilicate as the poison, sold under the name of Go West, is effective against the weevil stage and should be scattered around in June. Spraying foliage of yew, rhododendron, and other ornamentals with lead arsenate in June is highly effective in preventing chewing and should be done if weevils are numerous enough to warrant such discoloration.

In greenhouses adults can be kept from crawling from permanent bench plants to pots of annuals by boards painted with sticky tanglefoot. Weevils can be shaken off plants at night, or trapped under boards during the day, or killed with Go West. Cryolite has been used successfully in California as a spray to protect ornamental plants from the ravages of this weevil.

Boll Weevil, or **Cotton Boll Weevil** (*Anthonomus grandis*)—Considered the most notoriously evil insect in all the world, yet with such a beneficial influence on methods of agriculture in one section of the country that it has had a monument erected to it! As home gardeners you are not directly concerned with controlling the boll weevil, but as citizens you are profoundly affected by it. It has been estimated that every person in the United States pays ten dollars a year more for cotton goods just because of the boll weevil. In the fifty-odd years since it arrived in Texas from Mexico, in 1892, it has closed down cotton gins and oil mills, caused banks to fail, depreciated land values, made wealthy growers into paupers, and it still costs us an enormous amount each year.

If, when the boll weevil was first noted, a barrier zone about 50 miles wide had been instituted, an area where no cotton was grown, the weevil might have been kept in bounds, just as the gypsy moth has been confined to New England. But at that time it did not seem possible to live in Texas without growing cotton, and rather than take away the source of livelihood from families in the area, the Texas legislature turned thumbs down on that proposal and let the boll weevil go its destructive way.

The weevil is small, 1/4 inch long, hard-shelled, yellow, gray, or brown and nearly black with age, covered with grayish fuzz, with a slender snout. It lays an egg in 100 to 400 cotton buds or squares and there may be eight to ten generations a year. It sometimes feeds also on okra, hollyhock, and hibiscus, which are related to cotton.

When boll-weevil devastation was at its height, cotton farmers learned

to do two things. One was ordinary sanitation, clearing the fields and burning old stalks, just as is recommended for practically every pest in this manual. The other thing they learned was diversification of crops. They grew corn, hay, potatoes, sugar cane, but especially peanuts and hogs; one county in Alabama cleared five million dollars on its first peanut crop. And so, at Enterprise, Alabama, the citizens of Coffee County erected a fountain in honor of the boll weevil, and put on it this inscription, which I once made a special trip to read:

IN PROFOUND APPRECIATION
OF THE BOLL WEEVIL
AND WHAT IT HAS DONE
AS THE HERALD OF PROSPERITY
THIS MONUMENT WAS ERECTED
BY THE CITIZENS OF
ENTERPRISE, COFFEE COUNTY, ALABAMA.

Broadbean Weevil (*Bruchus rufimanus*)—Attacking broad beans first, also peas and vetches. It is confined to the West coast, has several individuals in a seed instead of one, and is slightly smaller than but otherwise resembles the Pea Weevil, which see.

Carrot Weevil (*Listronotus oregonensis*)—Known on carrots and parsley for many years but a relatively recent pest of celery, feeding also on parsnips, dill, and related wild weeds. It occurs from New England to Georgia and west to Colorado. The beetles are dark brown, 1/4 inch long; the larvae are legless curved grubs. The beetles hibernate in grass and debris, lay eggs in May in cavities in leaf stalks. Grubs appear in 10 days, feed on inside of stalk, burrowing downward to the upper part of carrot root or into the celery heart. Feeding areas are rather zigzag and destroy much tissue. Mature in about 2 weeks, the larvae leave the root and pupate in soil near by. Beetles appear in July to lay eggs for a second brood of larvae injurious in August. There is sometimes a partial third brood.

Control. Rotation of crops is the standard treatment, although dusting with a calcium arsenate may possibly be effective, and using the Go West bait may help.

Cattleya Weevil (*Cholus cattleyae*)—Adults, just under 1/2 inch long, with white-marked backs, feed on pseudobulbs and puncture leaves. Larvae also feed on leaves and stems and afford entrance to decay organisms.

Control. Destroy by hand-picking, spraying, or dusting with lead arsenate.

Cowpea Weevil (*Callosobruchus maculatus*)—Present in southern states and California, where there may be six to nine generations a year. Yellowish grubs, 1/4 inch long, feed inside seeds in growing cowpea pods. Adults, bronze-black snout beetles 1/5 inch long, feed on plants and lay

eggs in holes eaten through pods. Sanitary and other control measures are about the same as for the bean weevil.

Cyclamen Weevil—See **Black Vine Weevil.**

Deodar Weevil (*Pissodes nemorensis*)—A native snout beetle formerly attacking pines—shortleaf, longleaf, slash, spruce, and loblolly—and more recently injurious to deodar, Lebanon, and Atlas cedars. It is found from southern New Jersey west to Missouri, and in Texas and the deep South, where it is active all winter. It gnaws through the bark with its beak and feeds on cambium, often girdling a leader or side branch. Eggs are laid in small holes in the bark; grubs, white with brown heads, 1/3 inch long, burrow in wood underneath and kill the leaders which start to die in January. Larvae pupate in March; beetles are around in April but soon disappear in surface litter to rest until fall.

Control. Practical control measures are not worked out, but stimulating the trees with commercial fertilizers or compost and by watering during dry periods seem to prevent attack and help deodars to survive.

Fuller Rose Weevil—See **Fuller Rose Beetle.**

Hickory Nut Weevil—See **Pecan Weevil.**

Figure 98

Imported long-horned weevil, showing characteristic long antennae and foliage injury

Imported Long-horned Weevil (*Calomycterus setarius*)—A Japanese pest first noted at Yonkers, New York, in 1929, a pest in Connecticut since 1932, and in the past few years reported from Illinois, Iowa, Maryland, Massachusetts, other places in New York, Pennsylvania, and Rhode Island. It is a general feeder, consuming foliage and blooms of grasses, legumes, flowering garden plants, vegetables, field crops, ornamental shrubs, house plants, vines. It also wanders into houses, crawls over walls and ceilings, gets into food. This insect is potentially dangerous and you should recognize it when you see it. (Figure 98.)

The adults emerge from soil about June 25 (about the date for Jap-

anese beetles) and are abundant during July and August. They are black, about 3/8 inch long, covered with grayish scales, have a coppery metallic cast, and feed chiefly on foliage, eating irregular areas in from the margin, like Fuller's rose beetle, of more than 100 plants. The preferred list of ornamentals includes abutilon, aster, begonia, Chinese lantern, chrysanthemum, columbine, daylily, rose, geranium, gladiolus, coleus, and English ivy. Swiss chard is given favor in a long list of vegetables. Adults are wingless and the natural spread is slow, but the weevils readily get around by crawling on people and into vehicles. Eggs are laid in sod; larvae are in the ground until the next June.

Control. In laboratory tests cryolite dust, used at 25 per cent with pyrophyllite as a diluent, has given best control.

Lily-of-the-valley Weevil (*Hormorus undulatus*)—Notches leaves in from the margin in curious fashion.

No control has been suggested.

Lupine Weevil (*Sitona grisea*)—Night-feeding snout beetles eat half-moons from margins of leaves, hide at base of plant during day.

Control with lead arsenate.

Monterey Pine Weevil (*Pissodes radiatae*)—Infesting ornamental Monterey and other pines along the coast of California. It mines the stems, tops, and bases of young trees above and below ground.

New York Weevil (*Ithycerus noveboracensis*)—Sometimes injurious to apple trees near woodlands and also a pest of young pears. Large gray snout beetles, spotted with black, 3/4 inch long, prune off twigs and small branches, especially on young trees.

Orchid Weevil (*Diorymerellus laevimargo*)—Attacks various species of cattleyas and dendrobiums. The beetles are 1/8 inch long, shiny black, with striated (grooved) wing covers, feeding on tender leaves or flower petals. Larvae are legless, curved, 3/16 inch long; they feed on new roots, hollow out old roots, causing tips to blacken.

Control. Pyrethrum dusts seem satisfactory.

Pales Weevil (*Hylobius pales*)—A native beetle, but noticeably injurious only since 1914; present from Maine to Florida and west to Minnesota and Arkansas. It feeds on white, pitch, red, and Scotch pines, American larch, Norway spruce, and other conifers, and recently has been noted as damaging loblolly and shortleaf pines in the South.

The weevil is reddish-brown to black, speckled with gray or yellow scales, with black head and thorax, 1/3 inch long. The larva is white with a light brown head, 1/2 inch long. Beetles feed on bark of seedlings mostly at night, girdling young trees near ground level and killing many, and also feed on twigs of older trees. They hibernate as adults, lay eggs in fresh-cut logs or stumps in May. Grubs burrow beneath bark, grow

slowly, pupate under the bark in September. The worst injury comes in the fall, after beetles emerge and before they go into hibernation.

Control. Spray ornamental pines with lead arsenate, making sure base of trunk is thoroughly covered.

Parsley Stalk Weevil—See **Carrot Weevil.**

Pea Weevil (*Bruchus pisorum*)—Present throughout the country. This is a short, chunky beetle, 1/5 inch long, brownish, flecked with white, black, and grayish patches. The larva is white, with small brown head. The female lays her eggs on the outside of a pea pod; the larva, on hatching, bores through the wall of the pod and into one of the young peas, growing inside for 5 or 6 weeks and consuming contents. It pupates inside the pea, and the adult emerges in 1 to 3 weeks. Although several larvae may enter a pea only 1 survives. There is no continuous breeding in storage as with bean weevils. Adults sometimes remain in stored seed for a year or two before emerging, but usually they come out soon after pupation and hibernate in any protected place.

Control. In home gardens dusting with 1 per cent rotenone every 4 or 5 days from time peas start to blossom until they go out of bloom will give nearly weevil-free peas. Destroy vines as soon as peas get beyond edible state. Many birds feed on pea weevils.

Pecan Weevil (*Curculio caryae*), also known as **Hickory Nut Weevil**—Found wherever pecans or hickories grow. In Georgia, Louisiana, and Mississippi this is probably the most important pecan pest, causing losses in some sections up to 80 per cent of the crop. The adults, dark brown, 3/8 inch long, attack newly formed pecans, causing them to shrivel and drop. The female has a beak longer than the body; that of the male is slightly shorter. The larvae, creamy-white, 1/4 to 1/2 inch long with reddish-brown heads, work in mature nuts in the fall. Eggs are placed in the pecan kernel, usually 3 eggs to a nut, as soon as the water stage has passed. Larvae emerge from nuts in late fall, go down 3 to 9 inches deep in the soil, stay there 1 to 2 years, then pupate in September or October, transforming to the adult in three weeks. These adults remain in the soil until the next August, when they come out to feed on the nuts. The complete life cycle, therefore, takes 2 to 3 years.

Control. Schley and Stuart are the only varieties requiring control measures. Trees are gently jarred by means of a padded pole, or by a tree climber who jars each limb with his foot. The weevils, which play possum when disturbed, relax their grip and drop down onto sheets spread below the tree. Before they recover they are rolled off the sheets into buckets containing a little kerosene. Trees should be jarred weekly, beginning about the middle of August, and continuing for 4 or 5 weeks, or so long as weevils are noticeable.

When the weevil infestation is large, nuts should be knocked from the trees early and those with clinging husks, which contain weevils, separated from the good nuts. The wormy nuts can be placed on screens in chicken houses, so the larvae will be eaten as they drop out of the nuts.

Pepper Weevil (*Anthonomus eugenii*)—A Mexican insect established in the Southwest and recently in Florida. Small white grubs feed inside buds of bell, sweet, or chili peppers, causing buds and most of pods to drop off. Adults are reddish-brown to black with a brassy luster; they have curved beaks, 1/10 inch long. There are several generations a year.

Control. Destroy all infested fruit promptly. In California repeated dusting every 7 days with a 50 to 50 mixture of cryolite and talc gives good control. The addition of rotenone to the dust takes care of aphids, which seem to be stimulated by cryolite, probably because it kills the aphid enemies. In Florida dusting with equal parts calcium arsenate and hydrated lime is satisfactory. In either case peppers must be thoroughly washed before use, by being agitated in a hot bath of 2 per cent hydrochloric acid to remove any poisonous residue.

Rough Strawberry Weevil (*Brachyrhinus rugostriatus*)—Similar to the black vine weevil, but smaller and browner. Adults feed on leaves; larvae damage roots of blackberry, raspberry, strawberry, and many ornamentals. Control with apple bait. See Black Vine Weevil.

Strawberry Root Weevil (*Brachyrhinus ovatus*), or **Crown Girdler**—Present through northern United States in strawberry, raspberry, loganberry, blackberry, cranberry, grasses, crucifers, cucurbits, deciduous trees and shrubs; a special pest of conifers in nursery plantings. It is much like the black vine weevil in looks and habits. The beetles are nearly black, 1/4 inch long with short, blunt snouts; the larvae are white, legless, curved.

Strawberries are stunted, leaves bunched together, darkened, with fine roots and crown eaten by grubs. Adults winter under trash and in old strawberry crowns; larvae winter in soil. The latter feed early in the spring, pupate in May and June (in the state of Washington), after which beetles appear to feed on leaves and fruit.

As a pest of conifers injury has been most serious on hemlock, Serbian spruce, and some varieties of arborvitae. Various pines, junipers, and Japanese yew may be infested.

Control. Poison baits containing dried apples and sodium fluosilicate (the commercial preparation is Go West) are helpful in the Northwest. Apply 1 tablespoon around the crown of each strawberry plant in spring just before overwintering weevils feed, and again in summer before new adults come out.

Strawberry Weevil (*Anthonomus signatus*)—An eastern pest of strawberry, raspberry, dewberry; also found on wild blackberry and cinquefoil.

The dark, reddish-brown, very small snout beetle winters under trash, is active early in spring when strawberries are coming into bloom. The female punctures buds with her long beak, inserts an egg, then crawls down and girdles the stem. The grubs feed in the buds and pupate there after about a month. Adults emerge about midsummer, feed for a short period, then hibernate.

Control. The most satisfactory control is a dust of 1 part of lead arsenate to 5 parts fine dusting sulfur applied as the plants are coming into bloom. Do not use this poison within 3 weeks of ripening. A rotenone-sulfur dust will give nearly as good control without harmful residue.

Sweetpotato Weevil (*Cylas formicarius elegantulus*), also known as **Sweetpotato Root Borer**—Confined to the Gulf states. Besides sweet potato it feeds on morning glory and other plants of the same family. The beetles are ¼ inch long, slender, with head, wing covers, and abdomen blue, but red thorax and legs, and a long black beak held out straight in front. It attacks potatoes in the field, entering near the stem, and breeds in stored potatoes. Maggoty grubs complete the destruction which may take 25 to 75 per cent of the crop.

Control. Sort out infested potatoes at harvest and feed to stock or destroy; clean up and burn all old vines, destroy volunteer sweet potatoes and related weeds, observe quarantine and certification regulations, dip plants in lead arsenate before setting, 1½ ounces to a gallon of water; spray vines with weak lead arsenate at 10-day intervals.

Vegetable Weevil (*Listroderes obliquus*)—A South American beetle, first observed in southern Mississippi in 1922. By 1935 it had spread over most of Mississippi, Louisiana, and Alabama, and scattered areas were infested in Florida, Georgia, South Carolina, Arkansas, Texas, and California. The weevils are buff-colored with a lighter V-shaped marking on the wing covers, ⅜ inch long. They have well-developed wings but seldom fly. They attack turnip, tomato, mustard, carrot, radish, potato, spinach, beet, sugar beet, cabbage, Swiss chard, cauliflower, onion, lettuce, feeding first in the crown of the plant, then defoliating whole plants, leaving only stem and midribs. The larvae are greenish, slug-like, ½ inch long; they feed voraciously on plants at night, along with adults.

The weevils go into a summer resting period in late April or early May under trash or loose bark on trees, remaining inactive until early fall, when they crawl to vegetable crops to feed and lay eggs, continuing throughout the winter, except in coldest weather. One female lays 300 to 1,500 eggs a season.

Control. Rotate crops and cultivate thoroughly to destroy pupae in soil; keep down weeds, rubbish, et cetera, along fence rows. On crops

where foliage is not edible, such as tomatoes and potatoes, dust or spray with cryolite. Use rotenone dust for crops to be used as greens.

Walnut Weevil—See **Butternut Curculio.**

White Pine Weevil (*Pissodes strobi*)—A constant threat to eastern white pine in home plantings and sometimes injuring Norway spruce, Scotch, pitch, and jack pines, perhaps other conifers. You can tell the injury at a distance, for the terminal leader is brown in sharp contrast to the rest of the tree. When the yellow footless grubs, 1/3 inch long, mine in the bark and sapwood of the terminal shoot they girdle it; when it dies, a lateral branch turns up and tries to replace the leader. Sometimes 2 laterals grow up and the tree is forked. Sometimes the tree is killed back beyond the leader.

Adult beetles are reddish to dark brown, somewhat mottled with brown-and-white scales, and with a white spot on lower third of each wing cover. The beak is rather long and conspicuous. Adults hibernate under cover on ground, feed in May, lay 2 or 3 pearly eggs in cavities dug in bark of leaders. Egg-laying continues through June. Larvae appear in 10 days, feed for 1 to 2 months, pupate for 10 to 12 days, and beetles start emerging in July, continuing until October, at which time they feed on new buds and bark before hibernating.

Control. Jar beetles from trees and catch in a net in May and June. Cut off infested leaders as soon as noticed, being sure to cut below the grubs. Cut off all laterals but one and tie it to a stake to replace the leader. Sometimes spraying with lead arsenate helps.

Willow Flea Weevil (*Rhynchaenus rufipes*)—A small, native snout beetle found from Maine to Iowa and in Oregon and California, Colorado and New Mexico. Principal host is the laurel-leaf willow, but the weevils feed also on other willows, Lombardy poplar, aspen, sometimes red birch. The grubs, dirty-white, 1/12 inch long, widest at the thorax, mine chiefly in willow leaves, sometimes in aspen and poplar.

The adult is a tiny, jet-black beetle, elliptical, covered with short gray hairs, with reddish-yellow antennae and legs. The weevils hibernate under loose bark or trash on ground, feed in May on opening buds, new leaves, eating circular holes, sometimes killing back twigs. They lay eggs in June in pits on underside of leaves; larvae mine in leaves and pupate there, beetles emerging in August.

Control. Spray with nicotine sulfate at a 1 to 600 dilution plus fish-oil soap the first half of June and again 2 to 3 weeks later.

Yucca Weevil (*Scyphophorus yuccae*)—Black with deeply grooved wing covers. It feeds on sap of living yucca in southern California while larvae breed in bases of green flower stalks and hearts.

WHITEFLIES

Whiteflies are small sucking insects belonging to the family Aleyrodidae (meaning like flour) of the order Homoptera. The adults have 2 pairs of wings which are broadly rounded and covered with snow-white waxy powder. Usually the wings are pure white but some species have dark spots or streaks. Whiteflies are often present in great numbers on undersides of leaves but rarely noticed unless the plant is disturbed, when they fly out in clouds.

Whiteflies are primarily tropical insects but they are abundant in the North in greenhouses and on house plants and are common on some garden plants during the summer. Their general life history is much the same for all species: Oval eggs, $1/100$ inch long, are attached to underside of leaves by short stalks. They hatch in 4 to 12 days into active, pale yellow, 6-legged crawlers. The crawlers move about for a short time, avoiding strong light, then insert their beaks, start sucking sap, and lose their legs, now looking like very small, very flat, oval scales with a marginal fringe of white waxy filaments. The 4-winged adults emerge after two more molts. After the first molt the cast skin remains as a case like a pupa case, and the adults differ so from the nymphs that the period before the last molt is often called a pupa stage, although actually whiteflies belong to the group with gradual metamorphosis. They secrete profuse honeydew, encouraging sooty molds.

Avocado Whitefly (*Trialeurodes floridensis*)—A pest of avocado in Florida, also occurring on papaya, banana, guava, anona, citrus. The adult has a pale yellow body with white wings; the pupa or nymph has a fringe around the body. The winter is spent in this inactive stage, then adults appear in early March and lay white eggs in circles on leaves. There are three generations and a partial fourth. For control see Citrus Whitefly.

Azalea Whitefly (*Aleyrodes azaleae*)—Present on azalea in the South, but not a major pest. The eggs are pale yellow, body of adult and pupae are greenish-white. Some leaves are injured by sucking of plant juices and are discolored by sooty mold growing in honeydew. The spray schedule to control lacebugs and other azalea pests will take care of whiteflies in the deep South.

Azaleas in the North are credited with infestations of the mulberry whitefly, but the whitefly I inevitably find on *Azalea indica alba* in New York and New Jersey does not have the dark nymphs of the mulberry species, and much resembles the azalea whitefly seen in Alabama. In New Jersey it is partially controlled with nicotine-sulfate-and-soap sprays

but seems to keep on breeding through the summer. It is more of a nuisance than a serious enemy since the shrubs survive years of whitefly sucking.

Citrus Whitefly (*Dialeurodes citri*)—The most important economic species, a native of Asia introduced into Florida prior to 1885, when it was found in injurious numbers on orange trees. It appeared in California in 1907 and later dates, but most infestations have been fairly well eradicated, so it remains for the most part a pest in the Gulf states, either the most important citrus enemy or ranking after purple scale. It injures through the consumption of sap and by the honeydew which encourages sooty mold all over fruit and foliage.

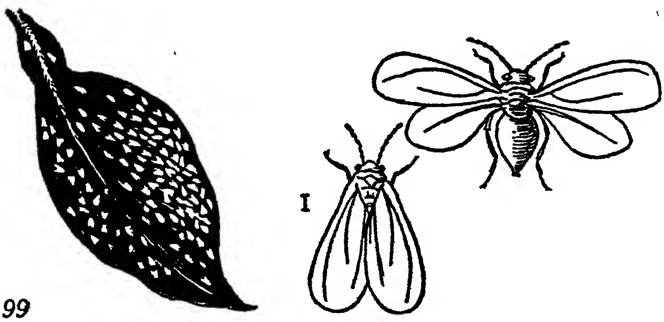


Figure 99

Citrus whitefly

It breeds in large numbers on chinaberry trees. Besides these and citrus, preferred food plants are umbrella trees, cape jasmine (gardenia), privets, Japanese and wild persimmons, lilac, coffee, prickly ash. Occasionally infested shrubs or vines include allamanda, banana, cerasius, camellia, choisya, cherry laurel, green ash, jessamine, pear, pomegranate, smilax, viburnum, wild olive, ailanthus, water oak, osage orange, palmetto.

The small yellow eggs, looking like dust, hatch in 10 to 12 days, those from unfertilized females turning into males. The nymphs are thin, translucent, scale-like, and losè legs and antennae after the first molt (about 7 days after hatching). The second molt is in 5 or 6 days, the third after 10 to 12 days, after which the insect assumes the pupa or resting stage, taking much less food, becoming thicker, and the outline of the adult taking form, the winged whitefly emerging through a T-shaped opening in the pupal skin. There are usually three generations in Florida, the spring brood of adults at its maximum in late March, the summer brood in June, and the fall—and largest—brood in late August or early September. (Figure 99.)

Control. Oil-emulsion sprays (such as Florida Volck) will control

whiteflies fairly well if applied to kill the nymphs before they change to adults. Two sprays in Florida, May and September, have been suggested, but for citrus the spray schedule should be directed toward all pests; and it varies in different states and even in different sections of Florida. Apply to your state experiment station for specific help.

Sometimes it is advisable to cut down chinaberry trees to reduce whitefly infestation. Parasitic insects are not so valuable as fungi in whitefly control. Cultures of the red whitefly fungus and the yellow whitefly fungus are prepared by the Florida State Plant Board and distributed to citrus growers for a small fee.

Cloudy-winged Whitefly (*Dialeurodes citrifolii*)—Similar to the citrus whitefly and chiefly a Florida pest, not found in California. Aside from citrus fruits, special hosts are yam vines and a species of ficus. The adult has a darkened area in each wing; the egg is black, covered with a network of ridges, often laid on succulent watersprouts. Maximum flight of the spring brood is in early April, summer brood early July, and fall brood late October.

Control. Remove and destroy watersprouts when most eggs are present —May, August, September, or January. Spray as for citrus whitefly or, if the cloudy-winged is the only species, spray about 3 weeks later. The yellow whitefly fungus is the one required to control this species (send a number of infested leaves to the state plant board and let it determine which species you have).

Crown Whitefly (*Aleyrodes coronatus*)—Abundant on live, valley, and tan oaks, Christmasberry, manzanita, wild coffeeberry throughout California. The pupa case is dark, surrounded with flat white waxy plates that give it a crown-like look.

Fern Whitefly (*Aleyrodes nephrolepidis*)—Found on various ferns in homes and greenhouses. Pupa case is bright yellow, without covering. Adults have pure white wings.

Glacial Whitefly (*Trialeurodes glacialis*)—On bush fruits, blackberry, boysenberry, loganberry, raspberry, and on bean, columbine, wild clematis, coffeeberry, ninebark, sage, snowberry, tan oak, in California. The young are yellow with a crystalline fringe; the adults pure white.

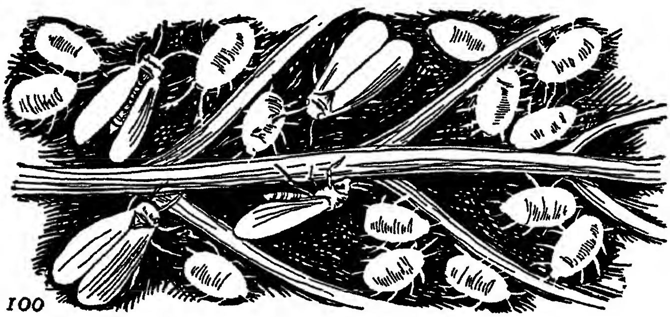
Control. Use rotenone or pyrethrum and oil sprays.

Grape Whitefly (*Trialeurodes vittatus*)—On leaves of European grape in California, but normally breeding on chaparral. The young appear in great numbers on underside of leaves, causing smutting of fruit and foliage with mold fungi. The pupa case is dark brown with a white marginal fringe.

Control. A fish-oil soap spray is effective if applied with pressure to undersides of leaves.

Greenhouse Whitefly (*Trialeurodes vaporariorum*)—The most common species in greenhouses and gardens. (Figure 100.) It does not live over winter outdoors in the North but gets to the garden with greenhouse-grown seedlings of tomatoes and other plants. The list of commonly infested hosts is long: ageratum, aster, avocado, barberry, bean, begonia, bignonia, blackberry, calceolaria, calendula, chrysanthemum, cineraria, coffeeberry, coleus, cowpea, cucumber, eggplant, fern, fuchsia, geranium, gourds, grape, heliotrope, hibiscus, honey locust, black locust, honeysuckle,

Figure 100



Nymphs and adults of greenhouse whitefly, much enlarged, on underside of leaf

Jerusalem cherry, lantana, lettuce, loganberry, lupine, mallow, morning glory, muskmelon, pea, pepper, potato, primrose, redbud, rose, sage, soybean, squash, strawberry, tomato, watermelon. In my own garden practice I always expect to find whiteflies on ageratum, eggplant, gourds, heliotrope, and in dense colonies on the undersides of squash foliage. Infested plants lack vigor, turn yellow, sometimes wilt and die; leaves are sooted with the black fungus mold.

The eggs are elongated, pale yellowish-green; the young are oval, thin, flat, pale green, and semi-transparent, with white waxy threads radiating from their bodies. The nymphal stages last about a month but under greenhouse conditions there are several overlapping generations. Both male and female adults as well as nymphs suck sap from undersurfaces of leaves.

Control. Cyanide fumigation at weekly intervals for 3 or 4 treatments is standard for greenhouses. If that is impossible, spray with nicotine sulfate and soap. Outdoors frequent applications of rotenone or nicotine will help control, but not entirely eliminate, whiteflies. Possibly the California recommendation of a white summer oil with pyrethrum concentrate would be useful in the East.

Iridescent Whitefly (*Aleyrodes iridescens*)—On California laurel,

Christmasberry, coffeeberry, manzanita, madroña, redberry, white sage. Nymphs are dark iridescent with star-like whorls on the surface and a fringe of white filaments. Adults are pale yellow with immaculate wings.

Inconspicuous Whitefly (*Aleyrodes inconspicua*)—Present along West coast on California laurel, Christmasberry, clematis, coffeeberry, maple, manzanita, live and tan oaks, Oregon-grape, or mahonia. It is also reported from Florida. The pupa case is pale or dark yellow with only a narrow fringe. The wings are dusky brown.

Iris Whitefly (*Aleyrodes spiraeoides*)—Often destructive to iris, feeding also on fuchsia, morning glory, honeysuckle, ninebark in San Francisco Bay region of California. The pupa case is pale yellow without waxy secretion or fringe. Adults have yellow bodies and dusky spots on wings.

Kellogg's Whitefly (*Aleyrodes kelloggi*)—Often present in numbers on leaves of Catalina cherry, growing wild or used as an ornamental. The pupa case is pale yellow, resting on dense white wax rods and covered with wide, flat white wax ribbons, so each one looks like a minute, beautiful flower.

Figure 101

Nymphs of mulberry whitefly, black with white fringe

Mulberry Whitefly (*Tetraleurodes mori*)—An eastern species that survives out-of-doors. Popular host plants include mulberry, dogwood, azalea, hackberry, holly, mountain laurel (kalmia), linden, maple, sycamore. The nymphs or pupa cases are elliptical, 1/35 inch long, jet-black edged with a white fringe of wax filaments; they sometimes cover undersides of leaves. (Figure 101.) Adults are around from June to September, increasing in numbers late in the season. Apparently there is no great injury to host plants.

Control. If a spray is warranted, use a summer oil and nicotine.

Pruinose Whitefly (*Aleyrodes pruinosa*)—Often present in enormous quantities on underface of Christmasberry leaves, causing serious smutting, in central and southern California. Pupa case is yellow to dark

brown with a frosty white covering. Adults have yellow bodies with brown markings, 2 dusky spots on each fore wing.

Rhododendron Whitefly (*Dialeurodes chittendeni*)—Yellowish mottling on upper side of leaves together with a rolling of margins is caused by greenish, almost transparent nymphs, flat, oval. Only rhododendrons with smooth underleaf surfaces are infested. There is much honeydew, accompanied by sooty mold.

Control. Spray with a light summer oil, as Volck, 1 to 50, on a cloudy day, covering terminal clusters and underside of leaves.

Strawberry Whitefly (*Trialeurodes packardi*)—A not too important pest of strawberries.

Woolly Whitefly (*Aleurothrixus howardi*)—Probably native to Florida on sea grape and later infesting citrus plants. The pupa is covered with woolly filaments of wax which gives the common name. Eggs are brown, curved, laid in circles as the female revolves around her inserted beak. The first young nymph is green; following stages brown with a wide fringe of white wax. Adults are yellowish, do not fly much. There are four broods.

Control as for the Citrus Whitefly.

WIREWORMS

Wireworms are the larvae of click beetles. They occur throughout North America, and over most of the world, as destructive pests of corn, small grains, grasses, potatoes, beets, carrots, and other root crops. They may also injure other vegetables, beans, peas, lettuce, radish and onions in particular; and flowers such as asters, dahlia, gladiolus, and phlox. Injury is usually most extensive in land recently taken over from sod, but in some sections the worms are numerous in soil continuously under cultivation. Wireworms may eat seed, resulting in almost total loss of a planting of corn or peas or other vegetables; or they feed on underground stems, causing death of seedlings; or eat the small roots of larger plants, or burrow into potatoes, carrots, or beets.

The larvae are smooth, wire-like worms (Figure 102) usually hard-shelled and dark brown in color, but in some species whitish and soft. They vary from ½ to 1½ inches long. The adults are hard-shelled tapering beetles (Plate XXIII, page 230) gray-brown to black, with the joint in front of the wing covers loose and flexible. When these beetles are placed or fall on their backs they right themselves with a sharp click. See also Click Beetles.

The beetles live from 10 months to a year, most of the time under-

ground. The egg stages last a few days or a few weeks, and the wireworms live in the soil anywhere from 2 to 6 years, moving downward as the upper surface of the soil dries out. In late summer of the year, when they become full-grown, they change to soft white pupae in earth cells. The beetles evolving from these cells do not come out of the earth until spring. There is little migration through the soil, larvae and adults spending their entire lives within a few yards of their birthplace.

A few representative species are given below, and control measures follow the descriptions.

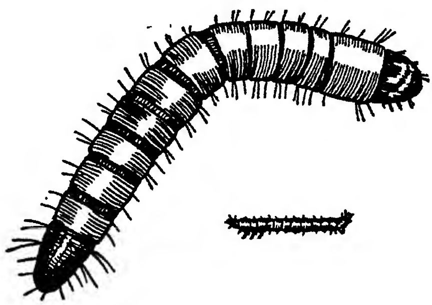


Figure 102

Wireworm, larva of a click beetle

Dry-land Wireworm (*Ludius inflatus*)—A robust, slate-gray to nearly black beetle, larva pale yellow, somewhat flattened. It is a root pest of potato, corn, oats, wheat, barley, with the adults feeding on buds and petals of wild rose and apple; particularly injurious in Washington, Oregon, and Idaho. Also present in California, Arizona, New Mexico, and eastern states.

Eastern Field Wireworm (*Limonius agonus*)—Probably the most common eastern species and found even on land which has been under cultivation for many years. It is a serious pest along Connecticut River tobacco areas and in upstate New York, attacking potatoes, beets, carrots, radishes, and onions; particularly destructive early in spring.

Great Basin Wireworm (*Ludius pruininus noxius*)—Found in dry areas east of the Cascades in Washington, Oregon, and Idaho. The beetle is black, slender, the larva yellow.

Gulf Wireworm (*Heteroderes laurentii*)—A southern species.

Plains False Wireworm (*Eleodes opaca*)—Found between the Mississippi River and the Pacific coast; preferring wheat but also attacking grasses, oats, corn, sugar beets, beans, and other garden crops. The beetle is black, with a flat back, sparsely clothed with white hairs. It cannot fly and when disturbed elevates the hind part of its body, keeping its head on the ground. The larvae are brown or yellow, prominently jointed.

Oregon Wireworm (*Melanotus oregonensis*)—Common on the West coast.

Spotted Click Beetle (*Monocrepidius vespertinus*)—The most common wireworm in Florida cornfields. The larva is a hard thick worm, about ½ inch long, found in both dry and wet soils, but it is more destructive in dry soil. Eggs are laid in summer, hatch in about 9 days, and larvae feed until the next spring, when they pupate in the ground. Another species, *M. lividus*, is common in Florida and found in the same soil.

Sugar-beet Wireworm (*Limonius californicus*)—Common in California and north to Washington. The adult is a small, elongate click beetle, ⅜ inch long, light or dark brown, with coarse punctures on the back. The larvae, typical shiny, yellow-brown hard worms, feed chiefly on roots of young plants—sugar beets, beans, corn, mustard, potato, chrysanthemum, aster, and other cultivated plants; also on weeds.

Western Field Wireworm (*Limonius infuscatus*)—Associated with the sugar-beet wireworm on the West coast, and particularly injurious to potatoes in sandy river-bottom land.

Wheat Wireworm (*Agriotes mancus*)—Pest of potato, corn, wheat, and a wide variety of plants across the country.

Control. Really successful control methods have yet to be devised. Chief among the partial remedies advocated are cultural methods, such as draining wet soils; avoiding grass sod and planting fields to more resistant clover or buckwheat; fall plowing to break up earth cells and expose larvae and beetles, but avoidance of deep plowing at other seasons; clean summer resting of land (letting it lie fallow) every second or third season, with shallow tillage to keep all vegetation down.

In small gardens it is possible to trap wireworms, previous to planting crops, by placing baits of germinating peas, beans, or corn, or slices of fresh vegetables under boards or buried in the soil. Often used as bait are potatoes, cut in two, and pressed 3 or 4 inches into the soil at 3-foot intervals, the spots marked with sticks. After a week they are dug up with their accumulated wireworms, destroyed, and fresh bait planted.

Fumigation is sometimes successful. Older recommendations include carbon bisulfide, 1 ounce to each hole, 3 or 4 inches deep, with holes spaced at 2-foot intervals. Or 2 pounds of crude naphthalene flakes may be broadcast for each 1,000 square feet and plowed in. Either of these methods must be used on fallow soil some time before planting. A newer material, dichlorethyl ether, is said to be safe around growing plants. A quart of a solution, containing 2 tablespoons per gallon of water, is used for each linear foot of row, or about a cupful per plant.

The newest hope for wireworms is DD Mixture, which promises to be as useful a soil fumigant against wireworms as it is against nematodes. See Nematodes.

WORMS

Caterpillars (larvae of moths and butterflies) and grubs (larvae of beetles) are sometimes commonly called worms, and so are considered here under that designation. For other "worms" see Armyworms, Cankerworms, Budworms, Cutworms, Corn Earworm, Fruitworms, Hornworms, Rootworms, Spanworms, Wireworms. For true worms, see Earthworms; and for roundworms or eelworms see Nematodes.

Ailanthus Worm (*Atteva punctella*)—A southern pest on the tree-of-heaven. The adult is a moth, with bright orange fore wings, marked with four crossbands of yellow spots on a blue ground, expanding to 1 inch. The hind wings are dusky, nearly transparent, with darker margins and blackish veins. The caterpillar is olive-brown with fine white lines. In Missouri the caterpillars feed, in a thin web, during August and September, and moths appear in September and October.

Control. None has been recommended, but a lead-arsenate spray would be effective for young larvae.

Black-headed Fireworm (*Rhophobota naevana*), or **Cranberry Worm**—A destructive cranberry pest. Eggs, overwintered on leaves, hatch when growth starts in spring, producing green larvae, first pale, then dark, with black heads, which web leaves together and feed inside. They pupate on the ground. The first brood of moths, ash-gray with irregular brownish bands across the fore wings, spreading to 3/8 inch, emerge in June, and those of the second brood in July or August.

Control. Flood the bog when the fireworm is in the pupa stage. Spray with lead arsenate just after eggs hatch.

Butternut Woolly Worm (*Blennocampa caryae*)—One of the sawflies, found on butternut, hickory, and English walnut. The false caterpillars are covered with long white filaments, standing straight up, and when several of them feed side by side on the undersurface of leaves they seem to be covered with masses of white wool. Underneath the filaments the larvae are pea green, about an inch long, with 8 pairs of prolegs (abdominal legs). They eat from the side of the leaf inward, often leaving nothing but the midrib. They pupate near the surface of the ground. The sawfly adult is black with reddish thorax.

Control. The injury is ordinarily not enough to call for spraying.

Cabbage Hairworm, or **Snake** (*Mermis albicans*)—A white, thread-like worm 2 to 9 inches long sometimes found in cabbage heads. It is really an internal parasite which has crawled out of grasshoppers or caterpillars and therefore a friend of man, even though you may not like

it in your head of cabbage. It does not feed on cabbage or injure it in any way.

Cabbage Worm—See **Imported Cabbage Worm,** in this section; **Cabbage Looper,** under **Caterpillars;** and **Diamond-back Moth.**

California Oak Worm (*Phryganidia californica*)—On live and other oaks, sometimes on chestnut and eucalyptus in California. It is particularly destructive to live oaks in the San Francisco Bay region, defoliating them in much the same fashion as do cankerworms in the East in peak years. (Figure 103.)

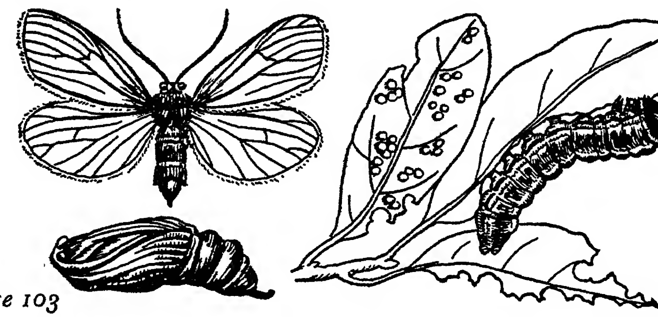


Figure 103

California oak worm—moth, pupa, eggs, and larva at work

Immature caterpillars feed on the leaves of live oaks during the winter; on deciduous oaks they winter as eggs. Mature caterpillars are olive-brown with black and yellow longitudinal stripes on back and sides. After feeding in spring they pupate in May and June in smooth white or yellow chrysalids attached by the rear end to leaves, limbs, or tree trunks. The moths emerge in June and July, lay flattened white eggs for the summer brood on any kind of oak, the adults of this brood appearing in October and November. They are uniformly pale brown, with slightly darker antennae and wing veins, with 1- to 1¼ inch wingspread. Only at long and irregular intervals, are they abundant enough to cause complete defoliation but protective measures should be taken each season.

Control. Have oaks sprayed thoroughly with lead arsenate (3 to 4 pounds to 100 gallons, plus ½ pint fish oil) in time for first brood of larvae in April and May. If this is not done, spray as soon as feeding is noticed. A bacterial wilt disease kills many caterpillars and is probably responsible for the intervals between the peak years, and there are also several insect enemies.

Carpenter Worm (*Prionoxystus robiniae*)—Widely distributed over the whole United States, attacking locust, poplar, cottonwood, willow, some oaks, ash, maple, apricot, pear, and other trees, being particularly injurious to live oak and elm on the Pacific coast. The name is derived

from the fact that the borer larva excavates large tunnels in solid wood of trees.

The female moth is 2½ to 3 inches across the wings; the fore wings are mottled gray; the much smaller hind wings are sober and uniformly brown. The body is stout but spindle-shaped. The male is similar but smaller, and has an orange-red spot on each hind wing. The caterpillar grows to 2½ inches, is white tinted with rose, has small brown hair-bearing tubercles and a brown head.

The larvae feed in the sapwood when young, later through heartwood of the trunk which may be riddled with burrows, as big as a lead pencil.

Female moths lay greenish-white sticky eggs in crevices of bark, in wounds, or old burrows, larvae feeding first on inner bark and soft wood. The life cycle takes 3 years or longer. The brown pupa is partly projected from the mouth of the burrow when the moth emerges.

Control. Use various measures described under Borers. Inject carbon bisulfide into openings, about a tablespoon each, and close with putty.

Celery Worm—See **Black Swallowtail,** under Caterpillars.

Chestnut Timber Worm (*Melittomma sericeum*)—A pest of chestnut (when we had any) and also of oak. The beetle is chestnut-brown, slender, ½ inch long. The larva is a slender white borer shading to dark brown toward the rear end. It probably enters through wounds, then bores galleries in sapwood and heartwood of dead and living trees.

Cross-striped Cabbage Worm (*Evergestis rimosalis*)—The larva is similar to other cabbage worms but has black bands across the body. The adult is a small, yellow-brown moth.

Gall-worm (*Monoptiloba sp.*)—A common pest of lima beans in Florida. The caterpillar, produced from egg laid on stem by a small moth, bores into the stem, which then forms a large swelling or gall, about the larva. Climbing varieties are more susceptible to injury.

Control. Since injury is chiefly in the summer, early planting will give a fair crop before the gall-worm is active. Fertilize and cultivate well for rapid growth.

Green Clover Worm (*Plathypena scabra*)—Present in eastern United States to Kansas and south to the Gulf of Mexico, and somewhat more injurious in the South. Although present in clover and alfalfa fields it is mostly a pest of soybeans, often completely destroying them; sometimes of garden beans, cowpeas, raspberry, and strawberry. Caterpillars are light green, striped lengthwise with darker green and white, a pale green hairy head, an inch long, very wriggly. The moths are dark purplish-brown; fore wings mottled with blue-gray, brown, and black; rear wings smoky brown, very broad. There are three or more generations in the South.

Control. Spray garden beans with nicotine sulfate and soap; or dust

with lime; or dust with cryolite diluted with talc or sulfur before pods form; or dust with rotenone.

Green Fruitworm—See under **Fruitworms.**

Green-striped Maple Worm (*Anisota rubicunda*)—A native eastern caterpillar found west to Kansas and Nebraska, attacking various maples, boxelder, and oak. The larvae are pale yellowish-green, striped above with 8 light and 7 dark green lines. They have 2 horns on the thorax, 2 rows of spines on each side of the body, and 4 large spines near the end of the abdomen. They are said to feed somewhat more ravenously in Kansas and other parts of the western range, often defoliating maples twice in one year, and every tree on an avenue.

The moths are pale yellow banded with rose, spreading from 1½ to 2 inches. They lay pale green eggs in large masses on leaves. The larvae appear in 10 days, feed for about a month, pupate in the soil, and in 2 weeks second-generation moths appear, the caterpillars of this brood pupating in the soil over winter. In southern states there may be up to three generations.

Control. Have trees sprayed with arsenate of lead (3 to 4 pounds to 100 gallons) in time for young larvae of first brood. Several insect parasites and birds aid in control.

Imported Cabbage Worm (*Pieris rapae*)—A pest in North America since about 1860. Within twenty years of its arrival at Quebec it had spread all over the country east of the Mississippi River and now is present practically everywhere. It attacks all vegetables of the cabbage family—cabbage, cauliflower, kale, collards, kohl-rabi, Brussels sprouts, mustard, radish, turnip, horseradish, and related weeds; also nasturtium, sweet alyssum, mignonette, and lettuce.

The adult is the familiar white cabbage butterfly, with 3 or 4 black spots on wings which spread 1¼ to nearly 2 inches. The butterflies are around on sunny days very early in spring, the females alighting frequently, to glue an egg on the underside of a leaf, until each has deposited several hundred. Eggs are yellow, bullet-shaped, ridged. Velvety smooth green caterpillars, with alternating light and dark longitudinal stripes, start feeding in about a week, depositing repulsive pellets of excrement as they eat huge holes in leaves. When full-grown, about an inch long, they pupate in a naked gray, green, or tan chrysalid with angular projections suspended by a belt of silk from some part of the plant or from some other near-by object, even a building. The butterflies emerge in a week or two and there may be five or six generations. Hibernation is in the pupal stage. (Plate XXVII, page 270.)

Control. Dusting with rotenone is the easiest control measure for the home gardener, but it is safe to spray or dust with lead or calcium arsenate

(1 part arsenical to 3 parts lime) up to the time heads begin to form. Cryolite dust, diluted with talc or pyrophyllite, can be used up to the time cabbage heads are the size of baseballs, or broccoli starts to form flower buds.

Destroy old plant parts as soon as the crop is harvested, also such weeds as wild mustard, peppergrass, shepherd's purse on which first-generation worms develop. A number of natural enemies reduce the caterpillar population, among them a wasp, now generally established here, imported from Europe for the purpose.

Imported Currant Worm—See under **Sawflies.**

Lesser Apple Worm (*Grapholitha prunivora*)—An eastern pest, relative of the codling moth with the same type of life cycle. The larvae are smaller and somewhat reddish. The typical injury is feeding just under the skin of the apple close to picking time.

Control. Apples well sprayed for codling moth will not require special treatment.

Little Carpenter Worm (*Prionxystus macmurtrei*)—Present throughout eastern United States and west to Minnesota; often more injurious to oaks than the carpenter worm. It seems to prefer red oak and may injure young trees in street plantings. The female moth is a pepper-and-salt gray, with black vein-like lines on fore wings, which spread to 2 or 2½ inches; clear hind wings. Male moths are smaller, with a dark band on outer margins. Caterpillars are greenish-white, with a light brown head, prominent mouth parts, 2½ inches long. The injury produced and control measures are the same as for the carpenter worm.

Melon Worm (*Diaphania hyalinata*)—Rarely injurious north of the Gulf states though sometimes present elsewhere. It is a close relative of the pickleworm, with similar habits. The day-flying moth has pearly white wings margined with a narrow dark band, spreading to 1¾ inches. (Plate XXXVIII, page 393.) The body is brown in front of the wings and the silver-white abdomen is tipped with a bushy tuft of darker hair-like scales. The caterpillar is slender, greenish, and in most stages has 2 white stripes along the body. It feeds chiefly on foliage of muskmelon, cucumber, squash, and pumpkin, but is rare on watermelon.

Control. Derris-talc dusts containing 1 per cent rotenone are effective against melon worm. Do not use rotenone mixtures containing sulfur which may so injure vines as to prevent almost all fruit formation.

Orange-striped Oak Worm (*Anisota senatoria*)—A native eastern moth, sometimes found in other states, preferring white and scrub oaks, occasionally feeding on other trees. The moth, appearing in early June, is bright tan, with black dots and a white center spot on the fore wings, which expand to 2½ inches. Females lay white to coral-red eggs in

clusters on underside of leaves. The male is smaller and darker. The caterpillar is coal black with orange-yellow longitudinal stripes and black horn-like appendages at the end of the body, which is covered with short spines. Sometimes larvae are abundant enough to strip foliage from trees in midsummer. Pupation is in soil. There is usually one generation; sometimes two in the South.

Control. Have trees sprayed thoroughly with lead arsenate (4 pounds to 100 gallons) when first young caterpillars are seen.

Orange Tortrix—See under **Caterpillars.**

Palmerworm (*Dichomeris ligulella*)—A pest so ancient it is mentioned in the Bible. It is occasionally serious on apple in northeastern states but may be found from Maine to Texas. The caterpillars are olive-green, striped lengthwise with 2 white stripes on the side and 2 narrow white lines on the back, ½ inch long. They skeletonize the leaves, partially protected by a light web, and sometimes eat into young fruit. The small moths, only ½ inch across the wings, appear in July, and later hibernate, laying eggs the next spring.

Control. The regular June lead-arsenate spray for codling moth will control palmerworms.

Parsley Worm—See **Black Swallowtail,** under Caterpillars.

Pecan Carpenter Worm (*Cossula magnifica*), also known as **Oak** and **Hickory Cossid.** The larva bores in trunk and larger branches of pecan, oak, and hickory, its presence shown by reddish pellets at the base of the tree and pencil-size burrows marked at the opening with flaps made of silk and bits of chewed wood. The borer is 1½ inches long, pinkish, and covered sparsely with short hairs grown in tubercles. The moth is gray, mottled with brown and black, wings spreading 1¾ inches.

Control is not easy. See general directions under Borers.

Pickleworm (*Diaphania nitidalis*)—Especially destructive in the Gulf states, but found as far north as New York. Muskmelon, cucumber, and squash are seriously injured, but not pumpkin. Ripening fruits are bored into by white to green caterpillars, up to ¾ inch long, with brown heads and black spots across each segment in the younger stages, but a uniform green or copper when full-grown. Masses of green sawdust-like excrement are pushed out from holes in the fruit which rots, molds, turns sour. Early in the season the caterpillars work on stems, terminal buds, squash blossoms. Fruits in late crops are almost totally destroyed in some seasons. (Plate XXXVIII, page 393.)

Hibernation is as a pupa inside a rolled leaf, the moth not coming out until late spring—early June in some sections. The adult is distinguished by a long, slender body with a prominent brush of long, hair-like scales at the end of the abdomen; the wings, margined with a band of yellow-

brown, spreading to just over an inch. The moths fly at night, lay eggs in clusters of 2 to 7 on underside of fruits or stems, on tender buds or new leaves. The first generation is not very large, but moths emerging from pupation in July lay many eggs, and the third and fourth broods in August and September really get down to their devastating business. Each worm may enter several fruits before its growth is completed.

Control. As soon as a crop is harvested burn vines, unused fruits, adjoining weeds, and trash. Spade or plow in early fall to bury pupae. Plan for an early crop; use squash for a trap crop to keep worms away from melons, but destroy vines before larvae are full-grown in squash blossoms. Dust with 1 per cent rotenone (but not mixed with sulfur); or dust with cryolite diluted with 2 parts talc.

Potato Tuber Worm (*Gnorimoschema operculella*), sometimes called **Tuber Moth**—Present through the South from Florida to California and north through Virginia; very destructive to potatoes in warm dry regions. Eggplant, tomato, tobacco, and related weeds are also attacked. The adults, very small, narrow-winged, gray-brown mottled with darker brown, ½-inch wingspread, escape from storehouses in early spring and lay eggs, singly, on underside of leaves, or on exposed tubers. The larvae, pinkish-white or green, with dark brown heads, ¾ inch long, burrow in stems or petioles, or mine in leaves. Maturing in 2 to 3 weeks, they pupate inside dirt-covered silk cocoons, in trash on ground, emerging as adults in 7 to 10 days. The entire life cycle takes only a month, and there may be five to six generations a season, with most severe injury in hot, dry summers.

The adults of late-season generations work down through cracks in soil to lay eggs in tubers, the larvae at first working under the skin, later tunneling through the flesh with dirty silk-lined burrows. They come out of potatoes before pupating in odd corners around the storage room.

Control. Keep potatoes well cultivated and deeply hilled during growth. Cut and burn infested vines a few days before digging; do not leave newly dug potatoes exposed to egg-laying by moths during late afternoon or night. Destroy all culls. Potatoes in storage can be fumigated with carbon bisulfide (see Bean Weevil for directions). Avoid injury on tomatoes by not growing them immediately after potatoes.

Southern Cabbage Worm (*Pieris protodice*)—A southern species resembling the Imported Cabbage Worm, which see. The butterfly has more black markings on the wings and the caterpillar has 4 longitudinal yellow bands.

Injury and control measures are the same.

Spiny Oak Worm (*Anisota stigma*)—A southern species much like

the Orange-striped Oak Worm, which see. The caterpillar is bright tawny or orange with a dusky stripe along the back and prominent spines on thoracic segments.

Ugly-nest Cherry Worm—See **Ugly-nest Caterpillar.**

Yellow-headed Fireworm, or **Cranberry Worm** (*Peronea minuta*)—Sometimes injurious on drier cranberry bogs. The adult, a slate-gray moth with ¾-inch wingspread, lays eggs on leaves in May. Yellow-headed caterpillars web leaves together and feed inside, pupating in their nest in June, producing a second brood to feed in July, and a third in September.

Control. Keep bog flooded until about May 20. Spray drier bogs with lead arsenate just as eggs hatch, using 1 pound to 10 gallons of water.

Chapter VI

HOST PLANTS AND THEIR PESTS

In this section are sorted out under their different host plants (the plants which they attack) the thousand or more insects which are described in the Bug section. It is by no means a complete check list, since most plants have many more possible insect enemies than could be included between the covers of one book; but even in this abbreviated form the lists of pests under some plants, and particularly those given for fruit and shade trees, are appallingly long. This is partly because trees attract a great many insects, some of which are only occasional visitors and of no serious consequence; partly because these hosts are more important economically, and so more work has been done on their insects; and partly because the lists, in attempting to represent all parts of the country, contain many more insects than would ever be present in one section. Black Scale and Cottony-cushion Scale, for example, mean nothing to the New Englander with a maple tree. The Californian, however, has his warm-climate scales, and the New Englander's Cottony Maple Scale, to boot, though he will not have the eastern Maple Phenacoccus.

I have tried to lessen the impact of sheer numbers of pests by grouping them, first into sucking and chewing insects and then, so far as possible, into those which act the same way on the plant—as the borers together, caterpillars together, et cetera; or those which might call for the same general control measures. Sucking insects are listed first unless one or more of the insects in the chewing category seems to me more important on a certain plant. The more important pests are also marked off by position being placed first in a group of similar insects, or else given a brief comment.

In a few cases, where it seems particularly necessary, one or two suggestions are given on control, but in every case you should check back

to the Bug section for description, life history, and treatment. Even there control measures are not given for each individual aphid, for example, if control is the same as that given for aphids in general, and for other similar aphids which have been treated in more detail. *Always read the introduction to the group of insects as well as the text on a particular species.*

What do you do when you have an unknown caterpillar on a cherry? Well, you can look up all the insects listed under cherry that might be caterpillars, including loopers, woolly bear, webworms, moths, leaf rollers, et cetera, and see if your caterpillar fits any of these descriptions. I won't promise that your particular caterpillar is included, though it probably is, if it is doing much damage to your cherry. If that seems like too much work you can telephone your county agent, who may be able to tell you exactly which caterpillar happens to be chewing, at the moment, on cherries in your locality. Or you can forget about identifying the exact species of caterpillar and follow the general spray schedule suggested for cherries either in this manual or, preferably, by your own state experiment station. The fruit trees are difficult because they do have a great many possible pests. Exact identification is not always necessary, for if a spray schedule is followed for the prevalent and most injurious pests the less important insects are either taken care of incidentally or can be dismissed as not serious enough to warrant special treatment.

Let us suppose, however, that you are willing to devote a few minutes to try to trace down that cherry caterpillar. Many of the insects can be eliminated immediately by location. So far as feasible insects which have a limited distribution have been so designated. If you look up Omnivorous Looper you see that it is limited to California, hence could not possibly be your problem if you live in Illinois. I suggest that whenever you look up insects and find that they do not belong to your section you draw a pencil line through the name—lightly, for you might move and have to erase it. (I assume that since this is a working manual you own this copy you are reading and have not borrowed it from the public library or a neighbor.)

Besides crossing out the pests that do not live in your state it will also help if you put a check mark against the name of those caterpillars or other pests that you do identify and know are troublesome every year in your garden. If you have kept any garden records, pencil in the date when you first notice that caterpillar each year.

The groups under which the insects are found in the Bug section are listed below. If you want to learn more about Eastern Tent Caterpillar, find "Caterpillars," and then find "Eastern" in alphabetical order. If the approved common name does not have the word caterpillar in it, like

Yellow Woolly Bear, it is either grouped with other insects that do have caterpillar in their names, or else caterpillar is put in parentheses after the name.

True slugs are found under Slugs and Snails, but false slugs (like Pear Slug, or Cherry Slug), which are larvae of sawflies, are found under Sawflies; and in many cases this is indicated thus: Pear Slug (sawfly).

GROUPS UNDER WHICH INSECTS ARE DESCRIBED

Ant Lions
Ants
Aphid Lions
Aphids, including Phylloxera
Armyworms
Bagworms
Bees
Beetles, including flea beetles, bark beetles, blister beetles, brenthian, billbugs, gouger, ground beetles, fireflies, colaspis, chafers, lady-beetles, with Vedalia, sawyers, snout beetles
Birds
Bollworms
Borers, including prionus, twig pruner, tremex, twig girdler
Budmoths, including budworms
Bugs, including assassin bugs, chinch bugs, lacebugs, leaf bugs, lygaeid, pameras, plant bugs, red-bugs, spittle bugs, stink bugs
Cankerworms
Casebearers
Caterpillars, including butterflies, loopers, skippers, tortrix, tent makers, woolly bears
Centipedes, including symphylid or garden centipede
Cicadas
Corn Earworm
Crayfish
Crickets
Curculios
Cutworms
Earthworms
Earwigs
Fleahoppers
Flies, including Fruitflies
Fruitworms
Galls
Grasshoppers
Hornworms
Katydids
Lantern Flies or Lightning Leaf-hoppers
Leaf Crumpler
Leaf Folder
Leafhoppers
Leaf Miners
Leaf Rollers
Leaf Skeletonizers
Leaf Tiers
Maggots
Mammals, including armadillos, cats, chipmunks, dogs, gophers, ground squirrels, mice, moles, rabbits, rats, skunks, tree squirrels, woodchucks
Mantids
Mealybugs
Midges
Millipedes
Mites, including common red spider

Moths, including sphinx, epizeuxis
Nematodes
Newts
Orthezia
Pinworms
Psyllids, including sucker and psylla
Reptiles—snakes, lizards
Rootworms
Salamanders
Scale Insects
Slugs and Snails
Sowbugs and Pillbugs
Spanworms
Springtails
Termites
Thrips
Toads
Treehoppers
Walkingsticks
Wasps, including hornets, cicada killer
Webworms
Weevils
Whiteflies
Wireworms
Worms

HOST PLANTS AND THEIR PESTS

Abutilon (Flowering Maple)

Abutilon Moth—looper caterpillar chews foliage.
Imported Long-horned Weevil; Fuller Rose Beetle—feeds from leaf margins.

Greenhouse Whitefly—minute white flies on underside of leaves.
Root-knot Nematode—galls on roots.
Lesser Snow Scale—white; **Soft Scale**—brown; **Black Araucaria Scale.**

Acacia (Wattle)

Omnivorous Looper and **Orange Tortrix**—chewers (caterpillars).
Fuller Rose Beetle—feeds at night, from edge of leaves.

Cottony-cushion Scale—white, fluted; **California Red Scale**—round, reddish; **Greedy Scale**—small, gray; **Oleander Scale**—pale yellow; **San Jose Scale**—small, gray, nippled.
Ground Mealybug—white powdery bugs on roots.

Acanthopanax (Five-Leaf Aralia)

Four-lined Plant Bug—small, circular spots in leaves from sucking bug.

Aconite (Monkshood)

Four-lined Plant Bug—dark depressed spots in terminal leaves.
Cyclamen Mite—leaves, buds deformed.

Larkspur Leaf Miner—tan blotches on foliage.

AFRICAN VIOLET (*Saintpaulia*)

Broad Mite; Cyclamen Mite—leaves puckered, plant stunted, twisted.
Citrus Mealybug—white cottony masses at leaf axils.
Leaf Nematode—brown areas on veins and leaf spotting.

AGERATUM (Floss Flower)

Corn Earworm; Tobacco Budworm; Celery Leaf Tier—feed on foliage, buds.

Cyclamen Mite—deforms leaves, flowers.
Greenhouse Whitefly—very common in late summer; leaves are stippled white.

AILANTHUS (Tree-of-Heaven)

Cynthia Moth—large green caterpillar; **Ailanthus Worm**—small brown caterpillar found in South. Both devour foliage.
Brown Wood Borer—brown beetle, yellow larva, bores winding galleries.
Oystershell Scale—oyster-shaped shells on trunk—occasional pest.

AKEBIA

San Jose Scale—small, gray, on vines.

ALIBIZZIA

Lesser Snow Scale—pear-shaped, white.

ALDER (*Alnus*)

Alder Flea Beetle—small, steel-blue; common; may defoliate.
Alder Bark Beetle—western bark miner.
Poplar and Willow Borer; California Prionus; Pacific Flatheaded Borer.
Pacific Tent Caterpillar; Omnivorous Looper; Birch Skeletonizer; Birch Casebearer; Alder Leaf Miner—all chew foliage.

Woolly Alder Aphid—common, goes over to maple; **Hop Aphid; Alder Lacebug.**
Oystershell Scale; San Jose Scale; Lecanium Scale—brown, convex, western; **Willow Scale**—white, pear-shaped.

ALLAMANDA

Citrus Whitefly—an occasional pest.
Purple Scale—oyster-shaped, brown or purple.

ALMOND (*Prunus*)

Clover Mite; Common Red Spider; Two-spotted Mite; European Red Mite—foliage discolored, often drops.

Citrus Thrips—only rare infestations.
Waterlily Aphid—winter host for; **Plum Leafhopper**—transmits yellows.

Red-humped Caterpillar; California Tent Caterpillar; Omnivorous Looper; California Casebearer; Western Tussock Moth—feed on foliage.
Western Striped Cucumber Beetle; Tobacco Flea Beetle—occasional pests.
Peach Twig Borer; Western Peach Borer; Shot-hole Borer; California Prionus.
Oystershell Scale; San Jose Scale; Black Scale; Cottony-cushion Scale; Greedy Scale; Howard Scale; Olive Parlatoria.

Aloe

Oleander Scale—round, pale yellow; **Soft Scale**—brown; **California Red Scale; Hemispherical Scale**—glossy brown.

Alstroemeria

Banded Greenhouse Thrips.

Alyssum (Sweet Alyssum)

Imported Cabbage Worm; Diamondback Moth—green caterpillars feed on foliage.

Six-spotted Leafhopper—transmits aster yellows.

Amaranth or Love-Lies-Bleeding (*Amaranthus*)

Cottony-cushion scale—white fluted sacs.
Harlequin Bug—black with red markings—sucking insect.

Carrot Beetle—reddish-brown; works on roots.

Amaryllis (*Hippeastrum*)

Narcissus Bulb Fly; Lesser Bulb Fly—bulbs rotting, turning black.
Convict Caterpillar—black with white bands, rather common.
Black Blister Beetle—feeds on flowers in South; **Climbing Cutworm.**

Stem and Bulb Nematode—dark rings in bulb.
Bulb Mite—in rotting bulbs.
Banded Greenhouse Thrips; Greenhouse Thrips; Gladiolus Thrips—streaking foliage and flowers, deforming buds.
Common Red Spider; Citrus Mealybug—sucking pests.

Ampelopsis

(Many species formerly listed as Ampelopsis are now in the genus Parthenocissus. See Virginia Creeper.

Black Vine Weevil—larvae feed on roots, weevils chew foliage at night.
Japanese Beetle—particularly disastrous to the variety with blue-green berries, called turquoise vine or porcelain vine.

Anchusa

Six-spotted Leafhopper—transmits aster yellows.

Andromeda

Florida Wax Scale—white, waxy, tinged with pink.

Anemone (Windflower)

Black Blister Beetle—devours flowers, foliage of Japanese anemone; **Celery Leaf Tier**—webs foliage; **Cutworms**—destroy plants.

Lily Aphid and other species of plant lice.
Leaf Nematode—dark blotches on leaves; **Stem and Bulb Nematode**—rarely deforms stems, flowers, leaves.

Anthurium

Florida Wax Scale.

Apple

More than a hundred insects may injure apple. Some of these have a limited range and are only occasionally injurious; others are fairly universal, causing yearly losses. There are three chief causes of wormy apples. Codling moth is first in importance all over the country. Next come curculios, with the plum curculio often ranked second in importance to the codling moth, and apple and cherry curculios contributing their share. The third insect, the apple maggot or railroad worm, is not active until summer at a time when many gardeners think fruit-tree spraying should be over.

Most spray schedules are based primarily on controlling codling moth and will incidentally take care of a great many other chewing insects which would otherwise damage foliage or fruit. A fungicide is included to control diseases at the same application. Nicotine is added to take care of aphids, redbugs, and leafhoppers during the season, but a dormant or delayed dormant spray gives a head start on some sucking insects as well as controlling San Jose and other scales.

Spraying to obtain perfect apples is a very specialized business. The schedule varies according to the location and the season, and there may even be 3 different spray schedules advised for one state. Here in northern New Jersey the standard schedule for apple growers has called for 7 regu-

lar sprays and an occasional extra treatment. Tuning in on the six-o'clock farmer's radio program the other morning, I learned that the 1946 schedule for growers in southern New Jersey, where second-brood codling moth is more of a problem, calls for possibly 14 sprays a season. It is no wonder, therefore, that back-yard farmers who spray only once or twice a season should still have wormy apples. I am not saying that you should spray more, for the apples you would get might not be enough to pay for the time and energy expended.

Five applications are considered the minimum required to get reasonably healthy, not perfect, fruit in a home garden. You often cannot afford to have a tree expert with power apparatus put on those 5 applications, nor can he afford, with his other more lucrative shade-tree work, to time the sprays exactly right for the weather and different varieties. If you have large trees you may not have the equipment to do the job yourself, and so you compromise by having the tree man with his power sprayer come in for a delayed dormant spray, a calyx spray, and sometimes a third spray 10 days or 2 weeks later. In some years you get a very satisfactory crop; in other years, especially when the apple maggot is bad, you get nearly all wormy apples. And you can't blame the arborist for that, because he cannot, by spraying in May, control an insect which is underground until almost July. Where the number of sprays is so exceedingly limited it would be wiser in most sections to sacrifice the dormant application in favor of a later summer spray.

Another compromise that is becoming more popular is the growing of dwarf trees that can be taken care of without outside help and apparatus. One enthusiastic booster of dwarf fruit trees says that he gets reasonably good fruit just by dusting with sulfur and lead arsenate whenever he happens to think of it (but he thinks of it at reasonably frequent intervals). Another says he gets pretty good results by timing treatments for holidays when he has free time. Memorial Day might do for one of the codling-moth sprays and the Fourth of July for apple maggot, but the calyx spray does not come on any holiday in my calendar.

The following spray schedule with variations is a guide only. (Figure 104.) You can streamline it to include only those 3 to 5 sprays most necessary in your own locality, but first be sure to check with your own county agent. He will know exactly what you need, and when.

Apple Spray Schedule

(Can be adapted for pears and cherries; *must not* be used on peaches, plums)

1. *Dormant to Delayed Dormant Spray*—DESIRABLE

Apply in early spring up to the time buds have green tips and are ¼ inch long—to control scale insects, aphids, apple scab.

1½ cups concentrated lime-sulfur
2 tsps. nicotine sulfate
1 gal. water

or

1 tbsp. Elgetol
1 gal. water

To kill eggs of rosy, green, and apple grain aphids.

or

Dinitro-compound-oil according to manufacturer's directions, to kill aphid eggs and San Jose scale.

or

3 per cent dormant oil emulsion, to control scale; increase to 4 per cent to control European red mite.

2. *Pre-pink or Cluster-bud Spray*—DESIRABLE

Apply when buds separate in cluster, primarily to control scab.

5 tbsps. lime-sulfur
1 gal. water

3. *Pink Spray*—IMPORTANT

Apply when the fruit buds show color, to control curculio, cankerworms, tent caterpillars, green fruitworms, and other chewing insects and scab.

6 tbsps. lime-sulfur
2¾ level tbsps. lead arsenate
1 gal. water

Add 1½ teaspoons nicotine sulfate per gallon to control redbugs, aphids.

4. *Petal-fall or Calyx Spray*—VERY IMPORTANT

Apply after 75 to 90 per cent of the petals have fallen and before the calyx closes, to control codling moth and other chewing insects, aphids, leafhoppers, redbugs, scab.

A

5 tbsps. lime-sulfur
2¾ level tbsps. lead arsenate
1½ tsps. nicotine sulfate
1 gal. water

1 gram each of manganese sulfate and soybean flour per gallon will make the spray safer and help it to stick.

or

B

Wettable sulfur according to manufacturer's directions (about 3 tbsps.)
1½ tsps. nicotine sulfate
2¾ tbsps. lead arsenate
Sticker-spreader according to manufacturer's directions
1 gal. water

or

C

4 tbsps. derris, cube or timbo powder containing 4 to 5 per cent rotenone
Wettable sulfur as above *or* 2 tbsps. wettable Fermate
Sticker-spreader
1 gal. water

5. *First Cover Spray*—IMPORTANT

Apply 7 to 10 days after No. 4; especially important for controlling curculio, also for caterpillars and scab.

Use B above, omitting nicotine if aphids are not serious, or C.

6. *Second Cover Spray*—VERY IMPORTANT

Apply 3 weeks after petal fall, to control codling moth especially; scab, aphids, leafhoppers if necessary.

7. *Third Cover Spray*—IMPORTANT

Apply 4 or 5 weeks after petal fall, to control codling moth. Use B or C, omitting nicotine.

8. *Apple-Maggot Spray*—VERY IMPORTANT

Apply in early July in New York and northern New Jersey, to control apple maggot and as a cover spray for codling moth.

2 level tbsps. lead arsenate
2 tbsps. wheat flour
1 gal. water

For very early summer apples in home gardens use rotenone instead of lead arsenate. For very late apple varieties an additional maggot spray can be applied later in July.

If later sprays are needed for codling moth use fixed nicotine.

From the above list select those applications needed in *your* garden, and if you can have only 2 or 3 sprays omit 1 and 2 and concentrate on those marked as important or very important.

Apple Insects—Major and Minor

San Jose Scale; Scurfy Scale; Oystershell Scale, apple variety—all three are common. Occasionally injurious in some sections are **Black Scale; California Red Scale; Cottony-cushion Scale; Cottony Maple Scale; European Fruit Lecanium; Florida Wax Scale; Forbes Scale; Greedy Scale; Green Shield Scale; Hemispherical Scale; Howard Scale; Italian Pear Scale; Lecanium Scale; Olive Parlatoria; Putnam Scale; Soft Scale; Walnut Scale.**

Apple Aphid; Rosy Apple Aphid; Apple Grain Aphid—all three curl leaves, deform fruits; **Woolly Apple Aphid**—white fluffy masses on trunks, galls on roots; **Clover Aphid; Cowpea Aphid; Hop Aphid; Mealy Plum Aphid; Potato Aphid.**

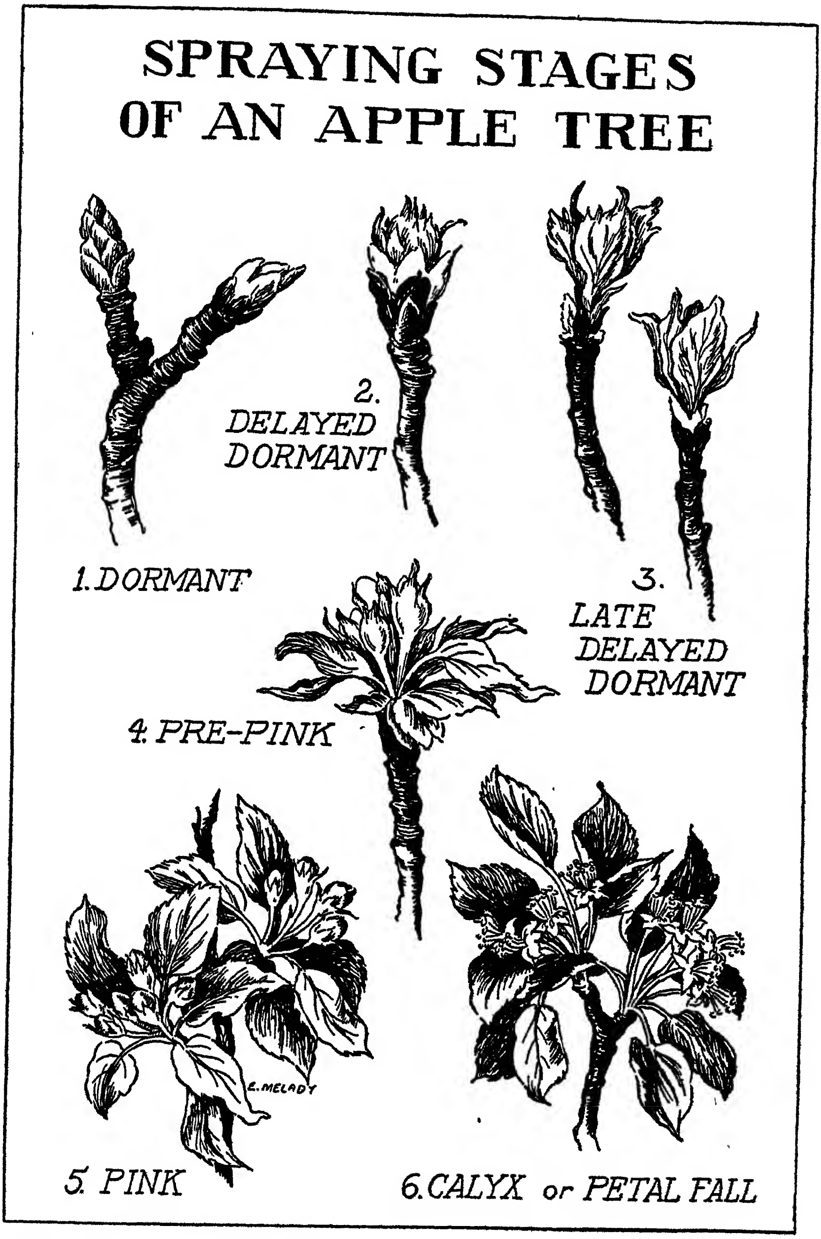


Figure 104 *Spraying stages of an apple tree*

Potato Leafhopper; Apple Leafhopper; Rose Leafhopper; White Apple Leafhopper—all turn foliage stippled white; **Grape Leafhopper; Three-banded Leafhopper.**

European Red Mite—foliage sickly, drops; **Clover Mite; Two-spotted Mite; Pear Leaf Blister Mite.**

Apple Redbug—pitted, deformed fruit, curled, pitted leaves; **Apple Lacebug; Boxelder Bug; Green Stinkbug; Tarnished Plant Bug; Willow Lacebug.**

Comstock Mealybug—increasingly important in East; **Citrophilus Mealybug; Grape Mealybug; Taxus Mealybug; Pear Thrips.**

Apple Sucker (psyllid); **Buffalo Treehopper; Periodical Cicada.**

Apple Maggot—common cause of wormy apples; **Mexican Fruitfly** (Texas).

Codling Moth—most important apple pest, wormy apples, or deformed.

Plum Curculio, Apple Curculio—crescent-shaped marks on fruit; white grubs inside.

Fall and **Spring Cankerworms**—frequently feed on foliage in spring.

Eastern Tent Caterpillar; California Tent Caterpillar; Coast Tent Caterpillar; Fall Webworm—all feed from webby nests; **Forest Tent Caterpillar**—feeds en masse but no real nest.

California Casebearer; Cigar Casebearer; Pistol Casebearer—cases protrude from leaves, worms feed on buds; **Eye-spotted Budmoth; Green Fruitworm**—work on buds.

Fruit Tree Leaf Roller; Oblique-banded Leaf Roller; Leaf Crumpler; Apple Leaf Trumpet Miner; Unspotted Tentiform Leaf Miner; Palmer Worm; Lesser Apple Worm; Red-humped Caterpillar; Saddled Prominent; Yellow-necked Caterpillar; Limetree Spanworm.

Apple and Thorn Skeletonizer and **White-marked Tussock Moth**—skeletonize leaves; **Rusty Tussock Moth; Western Tussock Moth; Apple Fruit Moth; Brown-tail Moth; Gypsy Moth; Oriental Fruit Moth; White-lined Sphinx.**

Japanese Beetle; Rose Chafer; Bumble Flower Beetle; Rose Leaf Beetle; Fuller Rose Beetle; Strawberry Rootworm; Strawberry Leaf Beetle; Cherry Leaf Beetle; Fig Beetle; Grape Colaspis; Green June Beetle; Western Striped Cucumber Beetle; Apple Flea Weevil; Potato Flea Beetle; Apple Flea Beetle; Grape Flea Beetle; New York Weevil; Imbricated Snout Beetle.

Roundheaded Apple Tree Borer; Flatheaded Apple Tree Borer; Pacific Flatheaded Borer; Shot-hole Borer; Western Peach Borer; Broad-necked Root Borer; Pear Borer; Pigeon Tremex.

Subterranean Termites; Dryland Wireworm; Grasshoppers.

Apricot

European Fruit Lecanium—brown; **Black Scale; San Jose Scale**—small, grayish; **Cottony-cushion Scale; Forbes Scale; Olive Parlatoria; Oystershell Scale; Soft Scale; Walnut Scale; White Peach Scale.**

Mealy Plum Aphid—splits, smudges fruit, stunts tree; **Black Peach Aphid; Green Peach Aphid; Thistle Aphid; Waterlily Aphid.**

Plum Leafhopper; Citrus Thrips; Pear Thrips; Western Flower Thrips; Clover Mite.

Fall and **Spring Cankerworms; Red-humped Caterpillar**—injurious only in late fall; **Yellow-necked Caterpillar; California Tent Caterpillar; California Casebearer.**

Fruit Tree Leaf Roller; Oblique-banded Leaf Roller; Orange Tortrix.

Cherry Fruit Sawfly—occasional pest; **Plum Curculio; Codling Moth; Oriental Fruit Moth; Western Tussock Moth.**

Western Spotted Cucumber Beetle—eats holes in fruit, spreads brown rot; **Plum Gouger; Fig Beetle; Fuller Rose Beetle; Green June Beetle.**

Peach Twig Borer—likes tender twigs, infests fruit; **Branch and Twig Borer**—small holes at base of buds, fruit spurs, twigs; **Shot-hole Borer**—brown beetle bores in sapwood; **Flatheaded Apple Tree Borer; Pacific Flatheaded Borer; Peachtree Borer; Western Peach Borer.**

Subterranean Termites.

Use dormant oil sprays for scales, dormant dinitro sprays for aphids. Control peach twig borer with a weak lead-arsenate spray at the redbud stage, and use sanitary measures for other borers. Use summer arsenical sprays on apricots with great caution, first consulting your experiment station. Try pyrethrum-thiocyanate dusts for beetles injuring fruit.

Arabis

Lily Aphid—yellow and black.

Aralia

Black Scale; Florida Red Scale—circular, brownish red; **Soft Scale**—brown.

Banded Greenhouse Thrips; Sugar-beet Thrips.

Ivy Aphid—dark brown, black, or purple.

Omnivorous Looper—variously colored measuring caterpillar; in California.

Serpentine Leaf Miner; Cabbage Butterfly.

Araucaria (Monkey Puzzle Tree and Norfolk Island Pine)

Golden Mealybug—covered with yellow wax; **Cypress Mealybug**—white; **Citrus Mealybug.**

Araucaria Scale—white; **Black Araucaria Scale**—nearly black; **Chaff Scale**—brownish-gray; **Florida Red Scale; Soft Scale**—brown.

ARDISIA

Hemispherical Scale—large, brown, convex.

ARBORVITAE (*Thuja occidentalis*)

Bagworm—small bags hanging on twigs; can see and prune off in winter.
Arborvitae Leaf Miner—tips of twigs whitened or light tan.
Hemlock Looper—yellow-green caterpillar with black dots.
Cedar Tree Borer—brown beetle, may girdle tree. **Red Cedar Bark Beetle.**

Common Red Spider and **Spruce Mite**—foliage dusty with fine webs, turning yellow.
Arborvitae Aphid—brown with white bloom; common in South.
Arborvitae Soft Scale and **European Fruit Lecanium**—brown; **Juniper Scale**—small, white; **San Jose Scale**—small, round, grayish.

ARTEMISIA

Artemisia Aphid—dark green or black.
Artemisia Scale—large white sacs; **Black Scale; Yucca Mealybug**—white.
Artemisia Gall Midges—swellings on plants.

Artemisia, especially in California, is subject to many other insects which have not been described in this manual.

ARTICHOKE, GLOBE (*Cynara scolymus*)

Artichoke Aphid—pale yellow to green; **Bean Aphid**—black.

Artichoke Plume Moth—yellow, black-headed caterpillar feeds in stems, heads; **Corn Earworm.**
Gray Garden Slug; Greenhouse Slug—feed on outer bracts of heads.

ASCLEPIAS (Butterfly Weed, Milkweed)

Oleander Aphid—black and yellow; **Melon Aphid.**
San Jose Scale; Western Flower Thrips.

Serpentine Leaf Miner—winding tunnels in leaves.
Monarch Butterfly—greenish caterpillar with black bands.
Argus Tortoise Beetle.

ASH (*Fraxinus*)

Oystershell Scale—often injurious, especially in Middle West; **European**

Fruit Lecanium; Howard Scale (Rocky Mountains); **Putnam Scale; San Jose Scale; Soft Scale; Terrapin Scale.**

Ash Flower Gall—on staminate flowers of white ash; **Citrus Whitefly.**

Lilac Borer—common and serious, tunnels in wood, scar tissue on trunk; **Ash Borer**—found in the Midwest; **California Prionus; Carpenter Worm**—very large tunnels; **Flatheaded Apple Tree Borer; Pacific Flatheaded Borer; Brown Wood Borer.**

Fall Webworm; California Tent Caterpillar; Great Basin Tent Caterpillar—webby nests on branches.

Fall Cankerworm; Hickory Horned Devil—green caterpillar with spines; **Brown-tail Moth; Polyphemus Moth** and **Promethea Moth**—large green caterpillars.

Brown-headed Ash Sawfly—may occasionally defoliate.

Lilac Leaf Miner—blotches in leaves; **Fruit Tree Leaf Roller; Oblique-banded Leaf Roller**—caterpillars feed inside rolled leaves.

Snowy Tree Cricket—may injure bark in egg-laying.

Asparagus

Asparagus Beetle—feeds on shoots, foliage; **Spotted Asparagus Beetle.**

Japanese Beetle; Spotted Cucumber Beetle—on foliage in summer.

Garden Centipede—important in California, injures shoots in ground.

Asparagus Miner—maggots girdle stems, foliage yellows.

Yellow Woolly Bear and **Orange Tortrix**—caterpillars sometimes present.

Bean Aphid; Melon Aphid; Lily Aphid; Potato Aphid.

Garden Fleahopper—very small, black, sucking insect.

Harlequin Bug; Say Stinkbug.

Bulb Mite—may injure underground stem.

A rotenone dust during the cutting period followed by lead or calcium arsenate during the summer is the usual schedule.

Asparagus Fern (Smilax)

Asparagus Beetle; Spotted Asparagus Beetle—sometimes defoliates.

Variegated Cutworm—climbs plants, clips stems below buds.

Garden Fleahopper—produces yellowed spots on foliage.

Onion Thrips—silvering, curling of leaves, with brown, corky spots.

Common Red Spider—mealy webs, loss of color.

Black Scale; Chaff Scale—transparent brown-gray; **Hemispherical Scale**—brown; **Lesser Snow Scale**—white.

ASPEN (*Populus tremuloides*)
(See also Cottonwood, Poplar)

Poplar Vagabond Aphid; Oystershell Scale.

Great Basin Tent Caterpillar; Red-humped Caterpillar; Poplar Sawfly; Willow Flea Weevil.

Poplar Borer; Bronzed Birch Borer.

ASPIDISTRA

Fern Scale—white, conspicuous; **California Red Scale; Florida Red Scale.**

ASTER, CHINA (*Callistephus chinensis*)

Six-spotted Leafhopper—greenish-yellow with 6 black spots, transmits aster yellows, causing stunted, deformed flowers; **Red-banded Leafhopper.**

Aster Root Aphid, Beet Root Aphid, Corn Root Aphid—grayish-white, powdery aphids working at roots; **Green Peach Aphid; Leaf Curl Plum Aphid; Potato Aphid.**

Tarnished Plant Bug—blackens new growth; **Goldenrod Lacebug**—foliage flecked with white.

Gladiolus Thrips; Banded Greenhouse Thrips.

Black Scale—not common; **Yucca Mealybug**—white sacs.

Black Blister Beetle—very common on flowers; **Margined, Gray** and **Ash-gray Blister Beetles**—less frequent; **Asiatic Garden Beetle**—chews foliage.

Celery Leaf Tier; Oblique-banded Leaf Roller; Wild Parsnip Leaf Miner—tie, roll, or mine in leaves; **Chalcedon** (caterpillar).

European Corn Borer; Stalk Borer—burrow in stems.

Garden Centipede—sometimes feeds on roots; **Root-knot Nematode**—galls on roots.

Screen out leafhoppers with a cloth screen; use nicotine for aphids on foliage and poured on ground for root aphids.

ASTER, NEW ENGLAND (*Aster Novae-Angliae*)

Aster Aphid—green; clustered thick on flower stems.

ASTILBE (often incorrectly called Spirea)

Japanese Beetle—descends on flowers and foliage in hordes.

AUCUBA (Japanese Laurel)

Aucuba Aphid—greenish.

California Red Scale, yellow variety of, makes openings for leaf-spot fungi.

Australian Pine (*Casuarina*)

Mining Scale—grayish; mines partly into bark; **Cottony-cushion Scale; Barnacle Scale**—brownish with white powdery wax.

Australian Silk Oak (*Grevillea*)

Citrophilus Mealybug—white with long filaments; **Grape Mealybug.**
Avocado Red Mite.
Greedy Scale—gray, convex; **Lesser Snow Scale**—white.

Omnivorous Looper (caterpillar).

Avocado

Avocado Red Mite—turns leaves and fruit brown.
Greenhouse Thrips—gives leaves and fruit a shiny brown surface; **Bean Thrips; Avocado Whitefly; Greenhouse Whitefly; Melon Aphid; Citrus Mealybug; Long-tailed Mealybug.**
Latania Scale—gray to yellow, most serious scale insect; **Black Scale; California Red Scale; Camphor Scale; Dictyospermum Scale; Greedy Scale; Hemispherical Scale; Florida Wax Scale; Lesser Snow Scale; Green Shield Scale; Oleander Scale; Purple Scale; Soft Scale.**

Avocado Caterpillar—skeletonizes leaves, scars fruit; **Omnivorous Looper; June Beetle; Fuller Rose Beetle.**
Branch and Twig Borer; Shot-hole Borer.

Azalea (*Rhododendron*)

Azalea Lacebug—leaves flecked with white or yellow, brown dots on underside; very common; serious.
Peony Scale—brown on twigs and branches; common and injurious in South; **Oleander Scale.**
Azalea Mealybug—white sacs on twigs; much sooty mold; **Citrophilus Mealybug.**
Greenhouse Thrips—leaves pale, covered with black excrement; common in South and in greenhouses; **Madrona Thrips.**
Southern Red Mite—causes foliage drop; **Cyclamen Mite**—occasionally.
Azalea Whitefly; Mulberry Whitefly—not very serious.

Azalea Leaf Miner—rolls leaves, mostly greenhouse pest.
Fuller Rose Beetle—feeds from margins of leaves.
Asiatic Garden Beetle; Black Vine Weevil—feed at night.
Azalea Sphinx (moth); **White-lined Sphinx.**
Azalea-stem Borer—yellow grub in twigs; **Rhododendron Borer**—works in wood near base.

BALSAM

(See Fir)

BALSAM, GARDEN (*Impatiens*)

Impatiens Aphid and other species.
Tarnished Plant Bug—blackens new shoots.
Root-knot Nematode—galls on roots.

Spotted Cucumber Beetle—eats holes in blossoms.

BAMBOO

Cottony Bamboo Scale—white, cottony sacs at leaf axils.
Bamboo Aphid—yellow with black markings.

BANANA

Banana Aphid—brown to black.
Long-tailed Mealybug; Pineapple Mealybug; Yucca Mealybug.
Citrus Whitefly—minute white flies on underside of leaves.
Black Scale; California Red Scale; Florida Red Scale; Hemispherical Scale; Soft Scale.
Root-knot Nematode—galls on roots.

BANKSIA (Australian Honeysuckle)

Purple Scale—oyster-shaped, brown to purple; **Black Araucaria Scale.**

BARBERRY

Barberry Aphid—small, yellow-green, on new shoots.
Barberry Scale—convex, reddish-brown, soft.
Greenhouse Whitefly—very occasional pest.

Barberry Webworm—dark, white-spotted caterpillars make webs over twigs; devour leaves.

BASSWOOD

(See Linden)

BAY OR SWEET BAY OR LAUREL (*Laurus*)

Laurel Psyllid—black, scale-like with white fringe.
Black Scale; Cottony-cushion Scale; Glover Scale—brown, narrow; **California Red Scale; Florida Wax Scale; Greedy Scale**—small, gray, convex; **Green Shield Scale**—with white sacs; **Dictyospermum Scale; Soft Scale.**

Eye-spotted Budmoth—brownish worm.

BAYBERRY (*Myrica*)

Red-humped Caterpillar—with bright red head and hump, chews foliage.

BEAN

Mexican Bean Beetle—yellow with black spots, the worst bean enemy, foliage skeletonized; **Bean Leaf Beetle**—yellow to red with 3 or 4 black spots; **Banded Cucumber Beetle**—green with 3 dark lines; **Blister Beetles**—several species; **Fuller Rose Beetle; Grape Colaspis; June Beetle; Rose Chafer; Spotted Cucumber Beetle; Striped and Western Striped Cucumber Beetle; White-fringed Beetle.**

Bean Weevil—grubs in stored beans; exit holes in seed coats.

Potato Flea Beetle—tiny holes in foliage; **Pale-striped Flea Beetle.**

Corn Earworm—feeds on pods; **Alfalfa Caterpillar; Salt-marsh Caterpillar; Yellow Woolly Bear; Fall Armyworm.**

Bean Leaf Roller; Oblique-banded Leaf Roller; Celery Leaf Tier; Beet Webworm; Garden Webworm; Serpentine Leaf Miner; Green Clover Worm; Gallworm, on Lima bean.

Seed-corn Maggot—tunnels in sprouting seeds; **Cowpea Curculio.**

European Corn Borer; Lesser Cornstalk Borer; Cutworms; Field Cricket.

Potato Leafhopper—may seriously devitalize; **Beet Leafhopper; Garden Fleahopper.**

Bean Aphid—small, black; **Cowpea Aphid; Melon Aphid; Potato Aphid; Turnip Aphid.**

Common Red Spider—foliage mealy; yellow; **Pacific Mite; Two-spotted Mite.**

Bean Thrips—foliage silvered; **Onion Thrips; Western Flower Thrips.**

Green Stinkbug; Harlequin Bug; Leaf-footed Bug; Pumpkin Bug; Tarnished Plant Bug.

Grape Mealybug; Greenhouse Whitefly; Glacial Whitefly.

Root-knot Nematode—galls on roots.

A rotenone dust will take care of beetles, aphids, caterpillars; if sulfur is the diluent, red spider will also be controlled.

BEEBALM (*Monarda*)

Beebalm Aphid—not described in other section; infrequent pest.

Stalk Borer.

BEECH

Woolly Beech Aphid—fluffy white masses on underside leaves of purple beech; **Beech Blight Aphid**—white, woolly; **Woolly Elm Aphid; Hickory Aphid**—large, gray.

Beech Scale—circular, pale yellow, covered with wax, associated with Nectria disease; **Black Scale; Cottony-cushion Scale; European Fruit Lecanium; Oystershell Scale; Putnam Scale; San Jose Scale.**

Grape Leafhopper—infrequent.

Eastern Tent Caterpillar; Cankerworms; Hemlock Looper; Saddled Prominent; Walnut Caterpillar; Yellow-necked Caterpillar; Elm Spanworm; Maple Casebearer.

Gypsy Moth; Imperial Moth; Io Moth; Luna Moth; Rusty Tussock Moth.

Flatheaded Apple Tree Borer; Pacific Flatheaded Borer; Brown Wood Borer; Pigeon Tremex; Leopard Moth.

Beet

Beet Leafhopper—important in West as vector (carrier) of curly-top disease. **Sugar-beet Leafhopper; Garden Flea Hopper.**

Bean Aphid; Beet Root Aphid; Green Peach Aphid; Melon Aphid.

Onion Thrips; Harlequin Bug; Tarnished Plant Bug, Root-knot Nematode.

Spinach Leaf Miner—tan blotches in leaves, very frequent; **Serpentine Leaf Miner.**

Potato Flea Beetle—minute, black; makes pinholes in leaves; **Pale-striped Flea Beetle.**

Beet Webworm; Cabbage Webworm; Small Beet Webworm; Spotted Beet Webworm; Celery Leaf Tier; White-lined Sphinx (moth) ; **Cabbage Looper.**

Vegetable Weevil—injurious in Gulf states; **Blister Beetles**—many species; **Asiatic Garden Beetle; Carrot Beetle**—works on root; **Spinach Carrion Beetle**—destructive in western mountain regions; **Spotted Cucumber Beetle; Western Striped Cucumber Beetle.**

Seed-corn Maggot and **Garden Springtail**—occasional injury to seedlings; **Cutworms; Beet Armyworm; Yellow-striped Armyworm; Grasshoppers.**

Eastern Field Wireworm; Plains False Wireworm; Sugar-beet Wireworm.

Despite the many possible pests not much spraying is done on beets in home gardens. Mined leaves are cut off, rotenone or pyrethrum applied to foliage likely to be used for greens.

Begonia

Citrus Mealybug and **Long-tailed Mealybug**—white cottony insects in leaf axils.

Greenhouse Thrips and **Banded Greenhouse Thrips**—leaves silvery with rust spots on undersurface, deformed.

Cyclamen Mite—plants stunted, leaves curled; **Broad Mite**—leaves glassy.
Begonia Aphid and **Melon Aphid**—often injurious to greenhouse begonias.
Greenhouse Whitefly; Common Red Spider.
Leaf Nematode—brown blotches on leaves; **Root-knot Nematode.**
Florida Red Scale; Mining Scale.

Black Vine Weevil—grubs may destroy roots of tuberous begonias; **Fuller Rose Beetle**—may eat leaf margins at night.
Orange Tortrix—leaf-rolling caterpillar sometimes on garden begonia.

Use nicotine sulfate and soap to control sucking insects before blooming but change to rotenone or pyrethrum while plants are in bloom.

Bergamot

Purple Scale.

Bignonia (Trumpet Flower)

Hemispherical Scale—brown, convex; **Lesser Snow Scale**—white; **Barnacle Scale**—brownish with white wax.
Citrus Mealybug—common; **Greenhouse Whitefly.**
Root-knot Nematode—galls on roots; occasionally.

Birch

Bronzed Birch Borer—often kills ornamental trees from top down. **Poplar and Willow Borer; Leopard Moth.**
Birch Leaf Miner—about half of each leaf turns brown; common.
Birch Leaf Skeletonizer—defoliates white birch, sometimes other varieties, about every 11 years; **Dusky Birch Sawfly; Birch Casebearer.**
Eastern Tent Caterpillar; Forest Tent Caterpillar; Fall Webworm; Hemlock Looper; Red-humped Caterpillar; Saddled Prominent; Variable Oak-leaf Caterpillar; Yellow-necked Caterpillar; Oblique-banded Leaf Roller.
Cecropia Moth; Gypsy Moth; Imperial Moth; Io Moth; Luna Moth; Polyphemus Moth; Rusty Tussock Moth.
Japanese Beetle—moderately serious; **Willow Flea Weevil; June Beetle.**

Birch Aphid—yellowish aphid injurious in late summer; **European Birch Aphid**—large, green, and black; **Witch Hazel Cone-gall; Spiny Witch Hazel Gall.**
Catkin Bug—feeds on catkins but not important.
Oystershell Scale—sometimes important; **San Jose Scale; Lecanium Scale; Terrapin Scale.**

BITTERSWEET, FALSE (*Celastrus scandens*)

Euonymus Scale—almost always encrusting canes and covering leaves with narrow, white male scales, a few brown females; **Oystershell Scale; San Jose Scale.**

Bean Aphid—black; **Spirea Aphid**—green; **Pea Aphid**—large, green.

Two-marked Treehopper—small sucking insect with bird-like profile.

Apply a dormant oil spray or Elgetol in spring; use nicotine sulfate and soap or a summer oil in growing season.

BLACKBERRY

Blackberry Psyllid—jumping plant louse; sometimes causes distortion, stunting.

Rose Scale—rather common, round, white; **San Jose Scale; Cottony Maple Scale; European Fruit Lecanium**—brown, convex.

Blackberry Mite—red, hard berry in West; **Common Red Spider** and **Pacific Mite**—leaves brown and drop.

Greenhouse Whitefly; Glacial Whitefly—common in warm climates.

Negro Bug—southern, gives bad taste to berries; **Strawberry Spittle Bug; Citrophilus Mealybug; Grape Leafhopper.**

Snowy Tree Cricket—injures with egg-laying punctures; **Black-horned Tree Cricket**—feeds on buds, flowers.

Red-necked Cane Borer—swellings in canes; **Blackberry Knot Gall; Raspberry Cane Maggot**—tips wilt, sometimes swellings; **Raspberry Cane Borer; Raspberry Root Borer; Currant Borer; Pacific Flatheaded Borer.**

Red-humped Caterpillar; Saddled Prominent; Yellow-necked Caterpillar; Yellow Woolly Bear; Oblique-banded Leaf Roller; Fruit Tree Leaf Roller; Strawberry Leaf Roller; Strawberry Crown Moth; Western Tussock Moth.

Blackberry Sawfly—leaves sometimes eaten by blue-green larvae; **Raspberry Sawfly.**

Blackberry Leaf Miner—blotch mines at leaf margins.

Japanese Beetles—injurious to fruit and foliage; **Fuller Rose Beetle; Green June Beetle; Imbricated Snout Beetle; Rose Chafer; White-fringed Beetle.**

Black Vine Weevil; Rough Strawberry Weevil; Strawberry Root Weevil; Strawberry Rootworm; Apple Flea Weevil.

Aside from cutting out infested canes and cutting out old canes each year, not many people try to do much about blackberry pests. Rotenone and pyrethrum are safe for summer application; sulfur dust is best for mites.

Blueberry

Blueberry Maggot—a form of apple maggot—rather common; wormy berries.

Blueberry Flea Beetle—grubs feed on buds; **Green June Beetle.**

Currant Spanworm; Azalea Stem Borer.

Blueberry Spittle Bug—white frothy masses.

Blueberry Thrips—curls, deforms buds and leaves.

Blueberry Stem Gall—hard, brown, kidney-shaped gall, common on twigs.

Oystershell Scale; Putnam Scale; Florida Wax Scale.

Boston Ivy (*Parthenocissus tricuspidata*)

(See also Virginia Creeper for other pests)

Japanese Beetle—devours new leaves; **Imported Long-horned Weevil.**

Eight-spotted Forester—caterpillar with black, white, orange crossbands.

Grape Leafhopper and **Virginia Creeper Leafhopper**—common in late summer; leaves whitish.

Cyclamen Mite; Calico Scale; Cottony-cushion Scale.

Bottlebrush (*Callistemon*)

Citrus Mealybug.

Bougainvillea

Soft Scale—brown.

Bouvardia

Leaf Nematode—blotches on leaves, flower cluster deformed.

Citrus Mealybug—white cottony sacs.

Boxelder (*Acer negundo*)

Boxelder Bug—red-and-black bug, more prevalent west of the Mississippi; feeds on foliage, flowers, fruit; **Green Stinkbug.**

Boxelder Aphid—green, hairy, with much honeydew.

California Red Scale; Cottony Maple Scale; European Fruit Lecanium; Oystershell Scale; Soft Scale; Walnut Scale.

Bagworms; Forest Tent Caterpillar; Fruit Tree Leaf Roller; Oblique-banded Leaf Roller; Green-striped Maple Worm; Fall Webworm; Spotted Tussock Moth.

Sweetpotato Flea Beetle.

Flatheaded Apple Tree Borer; Pacific Flatheaded Borer.

Boxwood (*Buxus*)

Boxwood Leaf Miner—very common and injurious; blisters in leaves with yellow-orange maggots inside.
Giant Hornet—may tear bark.

Boxwood Psyllid—terminal leaves curled into cups.
Boxwood Mite—leaves grayish.
Comstock Mealybug; Ground Mealybug.
Oystershell Scale—dark, oyster-shaped shells frequently covering twigs; **California Red Scale; Cottony-cushion Scale; Cottony Maple Scale; Lesser Snow Scale.**

Boysenberry

Glacial Whitefly and many of the pests listed under Blackberry, Raspberry.

Breadfruit (*Artocarpus communis*)

California Red Scale.

Broad Bean (*Vicia faba*)

Broad Bean Weevil.

Broccoli

(See also Cabbage for other pests)

Cabbage Maggot—seedlings wilt from white maggots feeding on upper root and underground stem; universal.
Potato and other **Flea Beetles.**
Cabbage Looper; Imported Cabbage Worm; Diamondback Moth—greenish caterpillars feeding on heads, foliage; **Corn Earworm.**

Cabbage Aphid—grayish lice clustered thick on leaves, flower head; very common.

Broom (*Genista*)

Bean Aphid—black.
Oleander Scale—round, flat, pale yellow; **Greedy Scale**—gray, convex.

Browallia

Aster Root Aphid—white, woolly at roots.
Six-spotted Leafhopper—transmits aster yellows.

Brussels Sprouts

(See also Cabbage)

Cabbage Aphid—grayish; **Harlequin Bug**—red and black.

Cabbage Maggot—seedlings wilt.
Cabbage Looper; Imported Cabbage Worm; Diamondback Moth.
Flea Beetles.

BRYOPHYLLUM

Lesser Snow Scale—white, pear, or oyster-shaped.

BUCKEYE (*Aesculus* spp.)
(See also Horsechestnut)

Oystershell Scale; Cottony-cushion Scale; Cottony Maple Scale; Walnut Scale; Grape Mealybug.

White-marked Tussock Moth; Omnivorous Looper (caterpillar).

BUCKTHORN (*Rhamnus*)

Melon Aphid; Black Scale; San Jose Scale.
Oriental Moth—vari-colored caterpillar—only near Boston.

BUDDLEIA (*Butterfly Bush*)

Banded Greenhouse Thrips; Root-knot Nematode.

Japanese Beetle—but not too serious; **Chalcedon** (caterpillar).

BURSERA (Gumbo-limbo)

Soft Scale—brown.

BUTTERNUT
(See also Hickory)

Oystershell Scale—rather common; **Walnut Scale**—round, gray.
Walnut Lacebug—leaves whitened.

Butternut Curculio—beetles puncture twigs, nuts; grubs in nuts.
Butternut Woolly Worm—hairy sawfly larvae may devour leaves; **Walnut Caterpillar**—black with white hairs; **Hickory Horned Devil; Yellow Woolly Bear** (caterpillar).
Hickory Tussock Moth; Imperial Moth; Luna Moth.
Strawberry Rootworm—beetle makes minute holes in foliage; **June Beetle.**
Painted Hickory Borer.

BUTTONBUSH (*Cephalanthus*)

San Jose Scale.

Cabbage

Cabbage Aphid; Turnip Aphid—grayish lice; very general.

Harlequin Bug—red and black; southern; **Green Stinkbug**—southern; **Squash Bug; Tarnished Plant Bug; Onion Thrips; Root-knot Nematode.**

Cabbage Maggot—seedlings wilt; **Seed-corn Maggot.**

Potato Flea Beetle; Sinuate Striped Flea Beetle; Western Black Flea Beetle; Western Striped Flea Beetle—all produce minute holes in leaves.

Imported Cabbage Worm; Cabbage Looper; Diamondback Moth; Cross-striped Cabbage Worm; Southern Cabbage Worm—all caterpillars devouring foliage; **Yellow Woolly Bear** (caterpillar); **Corn Earworm; Fall Armyworm.**

Cabbage Webworm; Beet Webworm; Celery Leaf Tier.

Cabbage Curculio—ash-gray weevil; **Vegetable Weevil**—important in Gulf states; also **White-fringed Beetle; Imbricated Snout Beetle; Red Turnip Beetle; Spotted Cucumber Beetle; Argus Tortoise Beetle; Black Blister Beetle; Rose Chafer.**

Slugs—make holes in foliage, enter heads; **Cutworms**—cut off seedlings.

Cabbage Hairworm—white, thread-like, non-injurious.

If cabbage seedlings are set out in tar-paper squares or given other protection against maggots, if collars or baits are used where cutworms are numerous and a rotenone dust applied throughout the season, there will not be too much trouble from cabbage pests in the home garden. Try Sabadilla dust if harlequin bugs are a problem.

Cactus

Citrus Mealybug; Long-tailed Mealybug—white cottony or woolly insects at base of spines, causing yellowing; **Root Mealybug**—lives on outer roots, may kill plant; **Tulip Bulb Aphid**—also on roots.

Common Red Spider—plants ashy or yellow with fine webs.

Cactus Scale—female gray; male white; **Greedy Scale**—gray, convex; **Lesser Snow Scale**—white; **Greenhouse Orthezia**—dark with white wax; **Oleander Scale**—pale yellow.

Cactus Fruit Gall.

Be careful with sprays on cactus—pyrethrum is usually safe, sometimes nicotine sulfate; Volck is a last resort. For red spider try water and glue as recommended for evergreens, washing off with warm water next day. Remove scales and mealybugs with pointed stick or stiff brush. For root mealybugs wash off all soil and repot.

Calamondin
(See also Citrus)

Citrus Rust Mite.

Calceolaria (Slipperwort)

Greenhouse Whitefly—minute, moth-like sucking insects.
Leaf Nematode—brown areas in leaves.
Green Peach Aphid; Lily Aphid, and other species.

Spray with nicotine sulfate when not in bloom. Avoid syringing and so spreading leaf nematodes.

Calendula

Bean Aphid—black; common; **Green Peach Aphid; Lily Aphid; Aster Root Aphid.**
Six-spotted Leafhopper—transmits aster yellows; **Red-banded Leafhopper.**
Composite Thrips—in flower head; frequent but not important.
Greenhouse Whitefly; Root-knot Nematode—galls on roots.

Black Blister Beetle—frequently devours flowers.
Cabbage Looper; Yellow Woolly Bear; Painted Lady—all caterpillars which may feed on foliage.

California Christmasberry, Toyon, or Mountain Holly
(*Photinia arbutifolia*)

Christmasberry Lacebug—disfiguring foliage with loss of color, brown flecks of excrement and sooty mold—common wherever Toyon grows.
Italian Pear Scale—shiny, dark gray, sunken in bark, associated with lichens; **European Fruit Lecanium; San Jose Scale; Black Scale; Oystershell Scale.**
Christmasberry Thrips; Greenhouse Thrips.
Crown Whitefly—waxy plates in form of a crown; **Inconspicuous Whitefly; Pruinose Whitefly; Iridescent Whitefly.**

California Tent Caterpillar; Omnivorous Looper; Western Tussock Moth.

California Coffeeberry (*Rhamnus californica*)

Greenhouse Whitefly; Inconspicuous Whitefly; Iridescent Whitefly; Glacial Whitefly.

California Tent Caterpillar; Western Tussock Moth.
Pacific Flatheaded Borer.

CALIFORNIA LAUREL (*Umbellularia californica*)

Lily Aphid—yellow and black; **Onion Thrips; Pear Thrips.**
Inconspicuous Whitefly; Iridescent Whitefly; Soft Scale.

Omnivorous Looper—yellow to green or pinkish striped caterpillar.

CALLA LILY (*Zantedeschia aethiopica*)

Long-tailed Mealybug; Grape Mealybug.
Banded Greenhouse Thrips; Greenhouse Thrips; Sugar-beet Thrips.
Bulb Mite.

Yellow Woolly Bear (caterpillar).

CAMELLIA

Tea Scale—the most important scale and general pest—white filaments on underside of leaves, with upper side yellowing; general debility; **Camellia Scale**—females brown, oyster-shaped, leaves may drop; **Black Scale; Camphor Scale; Chaff Scale; Florida Red Scale; Greedy Scale; Hemispherical Scale; Oystershell Scale; Peony Scale; Soft Scale.**
Citrus Mealybug; Citrus Whitefly; Root-knot Nematode.

Fuller Rose Beetle—notches leaves in from margin; **Black Vine Weevil.**

CAMPANULA (Bluebell)

Foxglove Aphid; Onion Thrips.

Garden Slugs.

CAMPHOR-TREE (*Cinnamomum camphora*)

Camphor Thrips—very injurious, dieback of buds, branches; bark cracking.
Camphor Scale—convex, blackish-brown; may cause defoliation, death; **Chaff Scale; Florida Red Scale; Greedy Scale; Oystershell Scale; Florida Wax Scale.**
Avocado Red Mite—leaves turn reddish; **Southern Red Mite.**

CANDYTUFT (*Iberis*)

Diamondback Moth—greenish caterpillar.

CANNA

Japanese Beetle—exceedingly fond of flowers; **Fuller Rose Beetle**—feeds on foliage; **Goldsmith Beetle.**
Larger Canna Leaf Roller—pale green caterpillar rolls and chews foliage; serious in South; **Yellow Woolly Bear** (caterpillar); **Celery Leaf Tier.**

Pineapple Scale—white and gray; **Latania Scale**—small, gray, convex. Lead arsenate with flour or other sticker is a good spray for leaf-feeders, but in some sections cryolite dust is preferable.

Cantaloupe

(See Melon for other insects)

Beet Leafhopper—transfers curly top; **Western Flower Thrips.**

Cape Jasmine

(See Gardenia for other insects)

Citrus Whitefly—almost always present.

Fuller Rose Beetle—notches leaves at margins.

Cape-marigold or African Daisy (*Dimorphotheca*)

Six-spotted Leafhopper—transmits aster yellows.

Caraway

Black Swallowtail—green, black-banded caterpillar.

Cardinal Flower (*Lobelia cardinalis*)

Negro Bud—reddish to black; southern; **Root-knot Nematode.**

Red-banded Leaf Roller; Wireworms—sometimes damaging.

Carnation (*Dianthus caryophyllus*)

Common Red Spider—very injurious, dusty webs, plants lose color, are stunted (sodium selenate a specific cure in greenhouses).
Western Flower Thrips; Onion Thrips—leaves silvering.
Green Peach Aphid; Grape Mealybug; Root-knot Nematode.

Cabbage Looper—green caterpillar; **Oblique-banded Leaf Roller; Celery Leaf Tier; Spotted Cutworm**—may climb stems to chew buds.
Fuller Rose Beetle.

Carob or St. John's Bread (*Ceratonia siliqua*)

Long-tailed Mealybug—white with long filaments at posterior end.
Oleander Scale—pale yellow.

Carpenter Worm—large, white to pinkish caterpillar making burrows in wood.

Carrot

Carrot Rust Fly—rusty tunnels in roots; plants dwarfed; serious in some sections.

Carrot Beetle and **Carrot Weevil**—brown; **Vegetable Weevil**—buff-colored, feeds on foliage at night; in South; **Asiatic Garden Beetle; Black Blister Beetle** and other species.

Potato Flea Beetle; Pale-striped Flea Beetle—shot holes in foliage.

Black Swallowtail—green, black-banded caterpillar; **Yellow Woolly Bear.**

Pavement Ants; Eastern Field Wireworm; Millipedes.

Corn Root Aphid—white powdery at roots; **Bean Aphid; Green Peach Aphid; Leaf Curl Plum Aphid**—green; western species.

Onion Thrips; Six-spotted Leafhopper—transmits aster yellows.

Cassava

Lesser Snow Scale—white, pear- or oyster-shaped.

Common Red Spider.

Cassia

Lesser Snow Scale—white; **Soft Scale**—brown.

Eggplant Lacebug—brown and yellow; **Root-knot Nematode.**

Castor-bean (*Ricinus*)

Cottony-cushion Scale—large, white fluted sacs; **Lesser Snow Scale.**

Common Red Spider; Potato Leafhopper.

Southern Armyworm—may defoliate and kill southern plants.

Catalina Cherry

European Fruit Lecanium—brown, convex; **Kellogg's Whitefly**—nymphs look like small white flowers.

Pacific Flatheaded Borer.

Catalpa

Catalpa Sphinx (moth)—large, dark, green-marked caterpillar, may cause almost annual defoliation in the Middle West.

Catalpa Midge—small brown spots in leaves.

Comstock Mealybug—white fluffs in bark crevices; may be serious; **Green Stinkbug; Melon Aphid; Root-knot Nematode.**

San Jose Scale; White Peach Scale.

Catnip (*Nepeta*)

Grape Leafhopper.

Small Beet Webworm.

CAT-TAIL (*Typha*)

Waterlily Aphid; Mealy Plum Aphid; Melon Aphid; Common Red Spider.

Potato Tuber Worm; Grasshoppers.

CAULIFLOWER

(See also Cabbage)

Cabbage Maggot—seedlings wilt.
Striped and **Western Striped Flea Beetles; Western Black Flea Beetle.**
Garden Springtail—occasionally feeds on seedlings.
Cabbage Looper; Imported Cabbage Worm; Diamondback Moth; Yellow Woolly Bear; Celery Leaf Tier; Cabbage Webworm.
Cabbage Curculio—weevil works on seedlings; **Vegetable Weevil.**

Cabbage Aphid and **Turnip Aphid**—grayish lice; common.
Harlequin Bug—red and black; **Tarnished Plant Bug; Onion Thrips.**

CEANOTHUS

Ceanothus Lacebug—black and brown; leaves whitened; prevalent.
Ceanothus Aphid—red-brown to black; **Lily Aphid**—black and yellow.
Greedy Scale—gray; convex; **San Jose Scale; Willow Scale**—white.
Yucca Mealybug—cottony sacs at axils; **Madrona Thrips.**

California Tent Caterpillar; Great Basin Tent Caterpillar.
Pacific Flatheaded Borer.

CEDAR, DEODAR (*Cedrus deodara*)

Black Scale—dark brown to black; hemispherical.

Deodar Cedar Weevil—grubs burrow in wood, kill leaders.

CEDAR, INCENSE (*Libocedrus*)

Cypress Scale—covered with white wax; **Juniper Scale**—small, round, white; **Pine Needle Scale**—white, oval; **Putnam Scale**—dark gray.
Cypress Mealybug.
Cypress Bark Beetle.

CEDAR, RED

(See Juniper)

CEDAR, WHITE (*Chamaecyparis*)

Juniper Scale.

Bagworm; Imperial Moth.

Celery

Celery Leaf Tier—may be major pest, green to yellow caterpillar webbing foliage, mining in hearts; **Oblique-banded Leaf Roller; Parsnip Webworm.**

Black Swallowtail—green caterpillar with black bands; **Cabbage Looper; Celery Looper; Yellow Woolly Bear; Southern Armyworm.**

European Corn Borer—sometimes in stalks.

Potato Flea Beetle; Carrot Beetle; Carrot Weevil.

Tarnished Plant Bug—dark areas on leaves and shoots; may be serious (try dusting with sulfur); **Negro Bug.**

Onion Thrips—foliage silvered; **Common Red Spider**—mealy webs.

Beet Leafhopper—transmits curly top; **Six-spotted Leafhopper**—transmits aster yellows; **Garden Flea Hopper**—minute black sucking insect.

Green Peach Aphid; Stem and Bulb Nematode.

Celosia (Cockscomb)

Common Red Spider—mealy webs; serious infestation in hot, dry weather unless syringed repeatedly.

Centaurea (Cornflower, Bachelor's Button)

Aphids—species not described in this manual—spray with pyrethrum or rotenone during blooming; **Aster Root Aphid.**

Six-spotted Leafhopper.

Stalk Borer.

Century Plant (*Agave*)

Oleander Scale—yellow; **California Red Scale; Lesser Snow Scale.**

Dracaena Thrips—dusky yellow.

Yucca Weevil—black billbug; **Yucca Moth.**

Cherry

Cherry Fruitfly and **Black Cherry Fruitfly**—maggots in fruits; **Cherry Curculio; Plum Curculio; Cherry Fruitworm; Apple Maggot; Cherry Fruit Sawfly; Codling Moth.**

Eastern Tent Caterpillar—nests very prevalent on cherry; **Forest Tent Caterpillar; California Tent Caterpillar; Coast Tent Caterpillar; Ugly-nest Caterpillar; Omnivorous Looper; Red-humped Caterpillar; Saddleback Caterpillar; Saddled Prominent; Yellow-necked Caterpillar; Fall Cankerworm; Yellow Woolly Bear; Fall Webworm.**

Pear Slug—skeletonizes leaves; **Cherry Casebearer; California Casebearer; Cigar Casebearer; Eye-spotted Budmoth.**

Leaf Crumpler; Unspotted Tentiform Leaf Miner; Fruit Tree Leaf Roller; Oblique-banded Leaf Roller; Red-banded Leaf Roller.

Brown-tail Moth; Western Tussock Moth; Oriental Fruit Moth.

Cherry Leaf Beetle; Imbricated Snout Beetle; Plum Gouger; Rose Chafer; Lesser Peach Borer.

Peachtree Borer; Shot-hole Borer; Brown Wood Borer; California Prionus; Flatheaded Apple Tree Borer; Subterranean Termites.

Black Cherry Aphid—inevitably infests young shoots and curls leaves; **Green Peach Aphid; Hop Aphid.**

Oystershell Scale; San Jose Scale; Calico Scale; European Fruit Lecanium; Forbes Scale; Glover Scale; Greedy Scale; Florida Wax Scale; Lecanium Scale; Putnam Scale; Terrapin Scale; Walnut Scale; White Peach Scale.

Boxelder Bug; Green Stinkbug; Harlequin Bug; Citrophilus Mealybug.

Onion Thrips; Pear Thrips; Citrus Whitefly; Clover Mite.

Buffalo Treehopper.

A cherry spray schedule is made up chiefly to control aphids, scales, plum curculio, the brown-rot fungus, and some leaf spots. In home gardens late arsenical sprays to control cherry fruitflies, causing maggoty cherries, are not safe, but rotenone can be used if desired. The early applications can be made with the spray mixtures made up for apples, a separate schedule followed for cherries.

Cherry Spray Schedule

1. *Dormant Spray*

Apply before the buds swell.

1½ cups lime-sulfur
1 gal. of water to control scales

or

Tar-distillate emulsion or Dinitro compound as recommended by manufacturer to control aphids, particularly on sweet cherries.

2. *Petal-fall Spray*

Apply as the last of the petals fall, to control curculio, cherry, and pear slugs, aphids, brown rot.

6 tbsps. lime-sulfur
2¾ tbsps. lead arsenate
5 tbsps. lime
1 tsp. nicotine sulfate
1 gal. water

Or use B or C as suggested under apples.

3. *Shuck Spray*

Apply when husks start to split from small fruits, to control brown rot, leaf spots, curculio, and apple maggot.

Same as number 2, but omit nicotine, or B, from the apple-spray schedule, without the nicotine, or C, from the apple-spray schedule.

C, the rotenone-wettable sulfur spray, can be repeated to control maggots or brown rot, but do not use lead arsenate after the Shuck Spray.

4. *Leaf-spot Spray*

Apply immediately after fruit is picked to prevent defoliation by leaf-spot fungi.

6 tbsps. lime-sulfur
1 gal. water
or
3-3-50 bordeaux mixture or Fermate.

The last spray, of course, is purely for disease control. A 90 to 10 sulfur-lead arsenate dust can be used on small cherries up through the husk application, but not thereafter.

Cherry, Japanese

Waterlily Aphid—when tree is near ponds; **Lightning Leafhopper.**

Cankerworms.

Cherry, Sand

Greenhouse Thrips; Green Stinkbug; San Jose Scale.
Plum Web-spinning Sawfly.

Cherry-laurel (*Prunus Laurocerasus*)

Citrus Whitefly.

Chestnut

A list of chestnut insects may seem of purely academic interest at this time, but some chestnuts are being bred and tested, there are some Chinese and Japanese chestnuts, and there is still the native chinquapin through the South.

Japanese Beetle—very fond of chestnut foliage.

Northern Brenthian, a snout beetle borer; **Broad-necked Root Borer; Brown Wood Borer; Dogwood Borer; Flatheaded Apple Tree Borer; Oak Sapling Borer; Twig Pruner; Two-lined Chestnut Borer**—important; **Chestnut Timber Worm.**

Omnivorous Looper; California Oak Worm; Cankerworms; Fall Webworm.

Brown-tail Moth; Gypsy Moth; Imperial Moth; Leopard Moth; Luna Moth.

Hickory Aphid—large, gray.

European Fruit Lecanium; Obscure Scale; Oystershell Scale; Putnam Scale; San Jose Scale; Terrapin Scale.

CHICK-PEA (*Cicer arietinum*)

Corn Earworm.

CHINABERRY (*Melia azedarach*)

Citrus Whitefly—breeds so profusely on this tree it sometimes has to be cut down around citrus groves.

Pacific Mite—yellowing foliage.

California Red Scale; Greedy Scale; Lesser Snow Scale.

CHINESE CABBAGE (*Brassica chinensis*)

(See also Cabbage)

Potato Aphid—Pink or green.

Cross-striped Cabbage Worm—green with black bands.

CHINESE LANTERN (*Physalis*)

Tortoise Beetles—various species, very convex, yellow—grubs and beetles feed on foliage; **Striped Cucumber Beetle**—yellow with 3 black stripes, often devours foliage, transmits mosaic; **Imported Long-horned Weevil.**

CHIONODOXA

Stem and Bulb Nematode.

CHOKEBERRY (*Aronia*)

Roundheaded Apple Tree Borer.

CHOKECHERRY

Eastern Tent Caterpillar; Ugly-nest Caterpillar; Fall Webworm.

CHOISYA (Mexican-Orange)

Citrus Whitefly.

Citrophilus Mealybug; Grape Mealybug.

CHRYSANTHEMUM

Leaf Nematode—brown wedges in leaves, progressive drying and dying up the stem; very common and injurious; probably the worst chrysanthemum pest outdoors; **Root-knot Nematode.**

Four-lined Leaf Bug—round, tan, depressed circles in new leaves, very common in late spring outdoors; **Harlequin Bug; Tarnished Plant Bug; Goldenrod Lacebug**—turns leaves whitish.

Chrysanthemum Thrips; Banded Greenhouse Thrips; Greenhouse Thrips—leaves silvery, dark flecked on underside.

Mexican Mealybug; Citrus Mealybug; Ground Mealybug; Greenhouse Whitefly.

Cyclamen Mite; Broad Mite; Common Red Spider.

Chrysanthemum Aphid—dark brown or black; prevalent; **Green Peach Aphid; Foxglove Aphid; Leaf Curl Plum Aphid; Melon Aphid; Myrtle Aphid; Thistle Aphid.**

Six-spotted Leafhopper—transmits aster yellows.

Black Scale; Cottony-cushion Scale; Hemispherical Scale.

Chrysanthemum Gall Midge—conical galls in new foliage, distorted buds; more injurious in greenhouses.

Asiatic Garden Beetle; Blister Beetles; Fuller Rose Beetle; Goldsmith Beetle; Spotted Cucumber Beetle; Imported Long-horned Weevil.

Chrysanthemum Leaf Miner; Celery Leaf Tier; Zebra Caterpillar; Variegated Cutworm; Chalcedon (caterpillar).

European Corn Borer; Stalk Borer—in stems. **Subterranean Termites.**

Cineraria

Green Peach Aphid; Leaf Curl Plum Aphid; Melon Aphid; Potato Aphid—may all seriously infest leaves; can control with fumigation.

Citrus Mealybug; Long-tailed Mealybug; Greenhouse Whitefly; Common Red Spider; Six-spotted Leafhopper; Root-knot Nematode.

Celery Leaf Tier—feeds in webs; may destroy all foliage; **Orange Tortrix**—leaf-rolling caterpillar.

Cabbage Looper; Cutworms—feeding at night on leaves and flower buds.

Spotted Slug; Greenhouse Slug.

Cinquefoil (*Potentilla*)

Small Green Rose Aphid.

Strawberry Weevil.

Cissus

Greedy Scale—gray, very convex.

Grapevine Aphid—black.

Fuller Rose Beetle—leaves eaten in from margin.

Citron

(See also Citrus)

Black Scale; California Red Scale; Hemispherical Scale; Soft Scale.

Citrus Rust Mite; Greenhouse Thrips.

Fuller Rose Beetle.

Citrus

(See also Grapefruit, Lemon, Orange)

Purple Scale—major pest, purple to brown, oyster-shaped; **Black Scale; California Red Scale; Florida Red Scale; Barnacle Scale; Chaff Scale; Citricola Scale; Cottony-cushion Scale; Hemispherical Scale; Florida Wax Scale; Lesser Snow Scale; Green Shield Scale; Mining Scale; Soft Scale.**

Citrus Rust Mite—fruit rusty, dry, rough; **Citrus Red Mite** (purple mite in Florida)—grayish cast to foliage; **Six-spotted Mite.**

Citrus Whitefly; Cloudy-winged Whitefly; Woolly Whitefly—devitalize trees, which are covered with sooty mold.

Citrus Mealybug; Citrophilus Mealybug; Long-tailed Mealybug; Grape Mealybug.

Citrus Thrips—scars fruit; **Greenhouse Thrips; Flower Thrips.**

Black Citrus Aphid; Melon Aphid; Potato Aphid; Spirea Aphid.

Cotton Stainer; Harlequin Bug; Leaf-footed Bug; Southern Green Stinkbug; Tarnished Plant Bug; Western Leaf-footed Bug.

Fuller Rose Beetle; Orange Tortrix (caterpillar)—bores in rind of fruit; **Branch and Twig Borer.**

Argentine Ant—disseminates scales, mealybugs; aphids; **Fire Ant.**

It is impossible to suggest a citrus-spray schedule that would be generally applicable. The Florida Citrus Commission gives 4 schedules to cover different situations in Florida, while the California control program differs in many respects. In general, oil sprays or fumigation or both are used for scale insects, and somewhat for whiteflies and mealybugs, but parasitic fungi are highly important in whitefly control and beneficial insects help take care of mealybugs. DN (Dinitro) Sulphur dusts or DN Oils are used for mites and tartar emetic for thrips.

For the home garden a cleanup spray in May or June, using a summer oil, is probably most important from an ornamental standpoint.

Clarkia

Six-spotted Leafhopper—transmits aster yellows.

Clematis (Virgin's Bower)

Common Red Spider—yellowing, webby foliage.

Glacial Whitefly; Inconspicuous Whitefly.

Soft Scale—brown; **Oystershell Scale.**

Root-knot Nematode—occasionally injurious even in North.

Black Blister Beetle—may devour flowers and foliage; mostly in South.

Omnivorous Looper; Clematis Borer—works in roots.

Clerodendron (Glory Bower)

Green Shield Scale; Soft Scale.

Coconut

California Red Scale; Florida Red Scale; Glover Scale.

Coffee (*Coffea*)

Black Scale; Camellia Scale; Tessellated Scale.
Citrus Mealybug; Greenhouse Orthezia; Citrus Whitefly.

Collards

(See also Cabbage)

Cabbage Aphid; Turnip Aphid—grayish lice; common.
Harlequin Bug; Southern Squash Bug.

Cabbage Looper; Imported Cabbage Worm; Diamondback Moth; Cabbage Webworm; White-lined Sphinx (moth).
White-fringed Beetle.

Coleus

Citrus Mealybug; Long-tailed Mealybug—white cottony insects at leaf axils.
Greenhouse Whitefly—hordes of tiny white "moths" underneath leaves; **Greenhouse Orthezia**—dark scale with white waxy plates.
Leaf Nematode—brown areas in leaves; **Root Nematode**—galls on roots.

Imported Long-horned Weevil—grayish snout beetle.
Greenhouse Slug; Spotted Slug.

Columbine (*Aquilegia*)

Columbine Aphid—cream-colored; abundant; **Foxglove Aphid; Lily Aphid; Melon Aphid; Spirea Aphid.**
Citrophilus Mealybug; Grape Mealybug; Glacial Whitefly.

Columbine Leaf Miner—white, winding tunnels in leaves; very common; **Wild Parsnip Leaf Miner.**
Columbine Borer—salmon caterpillar bores in crowns; serious; **Stalk Borer.**
Columbine Skipper—greenish caterpillar; **White-lined Sphinx** (moth).
Imported Long-horned Weevil.

Coralbells (*Heuchera*)

Strawberry Crown Weevil—plants destroyed by grubs at roots.

Leaf Nematode—brown blotches on leaves; **Mealybugs**—occasionally.

Coreopsis

Four-lined Plant Bug—small, tan spots in new leaves.
Potato Aphid—pink and green; **Six-spotted Leafhopper.**

Coreopsis Leaf Beetle—dark green with cream stripes; feeds on flower stems, leaves; **Spotted Cucumber Beetle.**

Corn

Corn Earworm—dark caterpillars at tips of ears; common, serious.
European Corn Borer—cream caterpillars at base of ears and in stalks, which may break over, sawdust protruding from holes; **Southern Cornstalk Borer; Southwestern Cornstalk Borer; Stalk Borer**—dark, striped caterpillar; **Elder Borer; Lesser Cornstalk Borer.**
Seed-corn Maggot—injures germinating seeds.
Japanese Beetle—feeds on silks, prevents pollination; **Argus Tortoise Beetle; Asiatic Garden Beetle; Blister Beetles; Bean Leaf Beetle; Bumble Flower Beetle; Carrot Beetle; Corn Sap Beetle; Click Beetle; Green June Beetle; Imbricated Snout Beetle; June Beetle; Rose Chafer; Seed-corn Beetles; Spotted Cucumber Beetle,** acting as the southern corn rootworm; **Striped** and **Western Striped Cucumber Beetles; White-fringed Beetle.**
Corn Flea Beetle; Desert Corn Flea Beetle; Pale-striped Flea Beetle; Potato Flea Beetle; Sweetpotato Flea Beetle.
Corn Billbugs—snout beetles injuring corn in whorl; **Corn Blotch Leaf Miner.**
Corn Rootworm; Corn Root Webworm; Blackheaded Sod Webworm.
Dryland Wireworm; Plains False Wireworm; Wheat Wireworm; Millipedes.
Fall Armyworm; Bronzed Cutworm; Range Caterpillar; Yellow Woolly Bear.
Grasshoppers; Squirrels; Birds.

Chinch Bugs—very important in Middle West; **Green Stinkbug; Harlequin Bug; Common Red Spider; Grass Thrips.**
Corn Leaf Aphid; Corn Root Aphid—woolly white lice at roots, distributed by ants; **Potato Aphid; Rusty Plum Aphid.**

It is possible to adjust planting dates to avoid some borer trouble. In New Jersey planting about May 15 matures corn between European corn borer broods and avoiding very late corn helps with the corn earworm. Dusting with rotenone, starting when the plants are young and dusting down into the whorl, and dusting silks with either rotenone or lime, prevent borer trouble and control Japanese beetles. For the corn earworm

either the oil injection or tying the tips of the ears is necessary. Corn problems differ in various sections, but probably in each region control efforts can be confined to a few insects, without worrying over the whole list presented here. Apply to your county agent or state experiment station for a specific program.

Cosmos

Potato Aphid—pink and green; **Aster Root Aphid**—white at roots.
Six-spotted Leafhopper—transmits aster yellows.
Common Red Spider—plants yellowing, grayish or mealy.

Japanese Beetle and **Spotted Cucumber Beetle**—very fond of light flowers; **Asiatic Garden Beetle**—feeds at night.
Stalk Borer—dark, light-striped caterpillar in stem; **European Corn Borer**—cream-colored; **Subterranean Termites.**

Cotoneaster

San Jose Scale; Oystershell Scale; Greedy Scale; Olive Parlatoria.
Hawthorn Lacebug—grayish stippling of leaf surface; brown flecks underside.
Pear Leaf Blister Mite—small, reddish to dark brown blisters.

Cotoneaster Webworm—webbing ends of branches.
Sinuate Pear Borer.

Cottonwood (*Populus balsamifera*)

(See also Poplar)

Poplar Leaf Aphid; Poplar Vagabond Aphid; Buffalo Treehopper.
Greedy Scale; Terrapin Scale; Walnut Scale.

Cottonwood Leaf Beetle; Cottonwood Leaf Miner.
California Tent Caterpillar; Great Basin Tent Caterpillar; Red-humped Caterpillar.
Bronzed Birch Borer; California Prionus; Carpenter Worm; Cottonwood Borer; Flatheaded Apple Tree Borer; Poplar Borer.

Cowpea

Bean Aphid—black; common; **Cowpea Aphid**—prevalent in Gulf states.
Southern Green Stinkbug; Leaf-footed Bug; Pumpkin Bug; Harlequin Bug; Garden Flea Hopper; Common Red Spider; Greenhouse Whitefly.

Mexican Bean Beetle; Bean Leaf Beetle; Blister Beetles; Grape Colaspis; White-fringed Beetle; Clover Root Curculio; Cowpea Curculio; Cowpea Weevil.

Velvetbean Caterpillar; Fall Armyworm; Garden Webworm; Green Clover Worm; Cutworms; Wireworms; Camel Cricket.
Serpentine Leaf Miner; Lesser Cornstalk Borer.

CRAB, ORNAMENTAL (*Pyrus* spp.)

San Jose Scale; Apple Aphid; Alder Lacebug.

Apple Curculio; Apple Maggot; Apple Flea Weevil; Strawberry Rootworm.
Codling Moth; Leaf Crumpler.
Roundheaded Apple Tree Borer; Flatheaded Apple Tree Borer.

CRANBERRY

Blackheaded Fireworm; Yellowheaded Fireworm; Cranberry Fruitworm—caterpillars web leaves, eat berries; **Gypsy Moth.**
Cranberry Rootworm; Black Vine Weevil; Strawberry Root Weevil.

Blunt-nosed Leafhopper—vector (carrier) for false-blossom disease.
Oystershell Scale; Putnam Scale.

CRAPEMYRTLE (*Lagerstroemeria indica*)

Crapemyrtle Aphid—profuse honeydew with sooty mold.
Florida Wax Scale.

CRASSULA

Cyclamen Mite—deformed.
Citrus Mealybug—may entirely cover stems with white woolly bodies, but most congested at leaf axils.

CRESS, GARDEN OR UPLAND

Cabbage Maggot; Serpentine Leaf Miner.

CROCUS

Green Peach Aphid; Bulb Mite.

CROTALARIA

Common Red Spider—leaves dusty, yellowing.

CROTON

Black Scale; Chaff Scale; Glover Scale; Hemispherical Scale; Florida Wax Scale; Lesser Snow Scale; Green Shield Scale; Purple Scale.
Citrus Mealybug; Long-tailed Mealybug; Greenhouse Thrips.

CUCUMBER

Striped Cucumber Beetle—yellowish with 3 black stripes; **Western Striped Cucumber Beetle; Spotted Cucumber Beetle**—greenish with

12 black spots; **Western Spotted Cucumber Beetle**—all these feed on foliage from the time the vines first appear, and transmit disease; **Banded Cucumber Beetle; Imbricated Snout Beetle.**

Potato Flea Beetle—small, black, making minute holes in leaves.

Melon Worm and **Pickleworm**—small greenish caterpillars burrowing in blossoms, vines, fruits; most serious in South; **Fall Armyworm; Cutworms; Celery Leaf Tier.**

Melon Aphid—carries bacteria causing wilt disease.

Beet Leafhopper—transmits curly top; **Garden Flea Hopper**—on seedlings.

Onion Thrips; Western Flower Thrips; Common Red Spider; Greenhouse Whitefly.

Garden Centipede; Root-knot Nematode.

Start plants under Hotkaps, later changing to cheesecloth or wire screening to give protection from all pests to young vines; when they get too big for covering start dusting with rotenone or cryolite.

Currant

Currant Aphid—leaves crinkled, cupped downward; greenish lice in pockets.

Four-lined Plant Bug—small, round, tan spots on new leaves; young bug red; adult green with 4 black stripes.

Oystershell Scale; Cottony Maple Scale; European Fruit Lecanium; Forbes Scale; Putnam Scale; San Jose Scale; Walnut Scale.

Currant Bud Mite—buds swell and die before opening; **Ground Mealybug; Grape Leafhopper; Common Red Spider; Two-spotted Mite.**

Imported Currant Worm—green, black-spotted larvae demolish foliage (see under Sawflies); **Currant Spanworm; California Tent Caterpillar; Western Tent Caterpillar; Yellow Woolly Bear; White-lined Sphinx** (moth); **Fruit Tree Leaf Roller; Oblique-banded Leaf Roller; Fuller Rose Beetle**—all these are occasional foliage-eaters.

Currant Fruitfly—maggots in fruit which turns red and drops prematurely; **Gooseberry Fruitworm**—worms in berries.

Currant Borer—canes yellowing, die back; **Flatheaded Apple Tree Borer; Pacific Flatheaded Borer.**

Most currant pests will be well enough controlled by cutting out infested canes and dusting with rotenone, although a nicotine-sulfate spray, directed toward undersides of leaves, may do a better job on aphids.

Currant, Yellow-flowering

Chrysanthemum Aphid; Currant Bud Mite; Oystershell Scale.

Imported Currant Worm.

CUSTARD-APPLE (*Anona reticulata*)

Florida Wax Scale; Hemispherical Scale.

CYCAD OR SAGO PALM (*Cycas, Zamia*)

Black Scale; Florida Red Scale; California Red Scale; Chaff Scale—gray-brown; **Hemispherical Scale**—brown, convex; common; **Green Shield Scale; Oleander Scale**—yellow; **Pineapple Scale; Purple Scale; Soft Scale; Zamia Scale**—reddish, wavy, convex.

Long-tailed Mealybug; Dracaena Thrips.

CYCLAMEN

Cyclamen Mite—plants deformed, stunted, buds blackened; prevalent and serious; **Broad Mite.**

Greenhouse Thrips; Melon Aphid; Lily Aphid; Root-knot Nematode.

Black Vine Weevil—grubs work on roots, may kill plants.

CYPRESS (*Cupressus*)

Cypress Aphid—large, green; **Arborvitae Aphid**—brown.

Cypress Bark Scale—leaves, especially on Monterey cypress, turn yellow or brown, may die; **Cottony-cushion Scale; Juniper Scale.**

Cypress Mealybug—white, common; **Date Mite; Southern Red Mite.**

Cypress Tip Moth and **Cypress Webbers**—small green larvae mine in twigs or web them together.

White-marked Tussock Moth—leaf-feeding caterpillar with tufts of white hairs; **Imperial Moth.**

CYPRESS, BALD (*Taxodium*)

Cypress Moth—caterpillar feeds on foliage.

DAHLIA

Potato Leafhopper—causing stunting of plants, curling of leaves, brown margins; prevalent; serious.

Tarnished Plant Bug—blackening of buds and new growth; **Four-lined Plant Bug**—small tan spots on leaves.

Greenhouse Thrips; Onion Thrips—transmits spotted wilt, petals turn white, wither.

Common Red Spider—mealy webs; **Cyclamen Mite; Root-knot Nematode.**

Bean Aphid—black; rather common; **Green Peach Aphid; Leaf Curl Plum Aphid.**

European Corn Borer—cream-colored caterpillar in stalk, plant dies; prevalent; **Burdock Borer; Stalk Borer**—dark—white-striped.
Spotted and **Western Spotted Cucumber Beetles**—eat flowers; **Asiatic Garden Beetle; Carrot Beetle; Grape Colaspis.**
Celery Leaf Tier; Yellow Woolly Bear (caterpillar).
Giant Hornet—may tear stalks; **Wireworms.**

DAISY, OX-EYE (*Chrysanthemum leucanthemum*)

Daisy Plant Bug—punctures leaves and flower buds; **Ground Mealybug**—may work at roots.

Chrysanthemum Leaf Miner; Celery Leaf Tier; Omnivorous Looper.

DAISY, SHASTA (*Chrysanthemum maximum*)

Four-lined Plant Bug—small, tan depressed circles in leaves; **Daisy Plant Bug**—punctures leaves, foliage.
Myrtle Aphid—green.
Spotted Cucumber Beetle—green with black spots, feeds on flowers; very common; **Chrysanthemum Leaf Miner**—irregular light mines over leaf, with yellow larvae of a black fly inside; **Chalcedon** (caterpillar).

DAPHNE

Citrus Mealybug; Aphids—various species.
Greedy Scale—yellow variety of **California Red Scale; Gray Citrus Scale**—scale insects common on *Daphne mezereum.*

DATE (*Phoenix dactylifera*)

Date Palm Scale—small, gray, and white; supposed eradicated; any new infestation should be reported; **Red Date Scale**—with cottony filaments; common but not serious.
Date Mite—yellow; webs leaves together, scars fruit; prevalent; **Banded Greenhouse Thrips.**
Western Leaf-footed Bug—large with leaf-like legs; **Grape Mealybug.**

DATURA (Angels Trumpet)

Tomato Russet Mite; Tomato Psyllid; Sugar-beet Leafhopper.

DAYLILY (*Hemerocallis*)

Flower Thrips—may streak blossoms, make foliage silvery; injurious.

Imported Long-horned Weevil.

Delphinium

Cyclamen Mite—by far the most important pest, blackening flower buds, stunting plants, deforming leaves; **Broad Mite**—glassy leaves.

Aphid, probably **Goldenglow Aphid**—red, on underside of leaves of perennial delphinium, cupping them downward, and between flower buds of annual larkspur, causing stunting, with blossoms sometimes failing to open; prevalent; **Green Peach Aphid; Lily Aphid.**

Common Red Spider; Gladiolus Thrips; Stem Nematode; Root-knot Nematode.

Four-lined Plant Bug—not so serious as on some other hosts.

Larkspur Leaf Miner—tan blotches in leaves.

Asiatic Garden Beetle; Japanese Beetle—not so injurious as on other flowers.

Stalk Borer; Burdock Borer—stalks may break, plants wilt.

Slugs—very common around delphinium; **Cutworms; Millipedes; Sowbugs.**

A strong rotenone spray used to control mites will control most other delphinium pests. Ashes around the crown will discourage slugs and cutworms.

Deutzia

Fuller Rose Beetle—leaves eaten in from margins.

Lilac Leaf Miner—tan blotches on leaves.

Currant Aphid—leaves crinkled; **Melon Aphid; Bean Aphid.**

Root-knot Nematode—may be serious in South.

Dewberry

(See also Blackberry and Raspberry)

Rose Scale—round, white; **Grape Leafhopper.**

Red-necked Cane Borer; Raspberry Cane Maggot; Blackberry Knot Gall.

Raspberry Sawfly; Oblique-banded Leaf Roller; Strawberry Leaf Roller; Strawberry Weevil.

Dill (*Anethum graveolens*)

Black Swallowtail—green, black-banded caterpillar.

Carrot Weevil.

Dogwood

Flatheaded Apple Tree Borer—injurious to young trees; **Dogwood Borer**—may cause death of limbs; **Dogwood Cambium Borer**—tunnels in

soft wood; **Dogwood Twig Girdler**—yellow grub in twigs which die back; **Azalea Stem Borer; Pecan Borer; Dogwood Club Gall**—swelling in twig.

Locust Leaf Miner; Red-humped Caterpillar; Oblique-banded Leaf Roller.

Dogwood Scurfy Scale; San Jose Scale; Cottony Maple Scale—white, cottony sacs with brown shield; **Obscure Scale.**

Mulberry Whitefly—round black nymphs with white fringe, on leaves.

Periodical Cicada—injures twigs by egg-laying; they hang down, dead.

Doronicum

Leaf Nematode—transparent to dark spots in leaves.

Lily Aphid—black and yellow.

Douglas Fir (*Pseudotsuga*)

Blue Spruce Gall Aphid—alternate host for; **Monterey Pine Aphid**—green.

Hemlock Scale; Pine Needle Scale.

Douglas-fir Beetle and **Douglas-fir Engraver**—bark beetles.

Cedar-tree Borer—may girdle and kill; **Fir Flatheaded Borer.**

Spruce Budworm—webs needles; **Pine Butterfly**—green, white-striped caterpillar; may defoliate; **Sequoia Pitch Moth; Zimmerman Pine Moth.**

Strawberry Rootworm—may injure or kill young nursery trees.

Dutchman's Pipe or Pipe-vine (*Aristolochia durior*)

Pipevine Swallowtail—brown caterpillar with red dots; eats foliage.

Echevieria

Root-knot Nematode.

Black Vine Weevil.

Eggplant

Potato Flea Beetle; Eggplant Flea Beetle; Pale-striped Flea Beetle; Tobacco Flea Beetle—tiny shot holes in leaves with loss of vigor.

Colorado Potato Beetle—convex, yellow, with black stripes; **Asiatic Garden Beetle; Blister Beetles; Spotted Cucumber Beetle.**

Potato Tuber Worm; Eggplant Leaf Miner—similar to tuber worm; **Yellow Woolly Bear** (caterpillar); **Tobacco Hornworm; Cutworms.**

Pepper Maggot—worms in fruit—occasionally.

Greenhouse Whitefly—often present in summer on plants started in

greenhouse; **Garden Flea Hopper**—tiny, black sucking pest; **Potato Leafhopper**—occasionally present; **Common Red Spider.**

Eggplant Lacebug—common in some sections; **Big Convict Bug; Cotton Stainer; Crane-fly Bug; Brown Stinkbug; Southern Green Stinkbug; Harlequin Bug; Pumpkin Bug.**

Green Peach Aphid; Melon Aphid; Potato Aphid.

Root-knot Nematode.

Elaeagnus (Russian Olive)

Artichoke Aphid—yellow and green.

Purple Scale; Olive Parlatoria.

Elder or Elderberry (*Sambucus*)

San Jose Scale; Aphids; Green Stinkbug; Grape Mealybug; Madrona Thrips.

Cloaked Knotty Horn (borer)—a dark blue beetle eating foliage, with cream-colored larva in stems; branches die back; **Currant Borer; Elder Borer.**

Potato Flea Beetle; Rose Chafer.

Omnivorous Looper; Black-horned Tree Cricket.

Elm

Elm Leaf Beetle—very injurious; in many regions the most important elm pest; leaves skeletonized, trees defoliated, weakened, subject to bark beetle injury, with death following several years' defoliation; **Great Elm Leaf Beetle**—more restricted in occurrence.

Smaller European Elm Bark Beetle and **Native Elm Bark Beetle**—carry Dutch elm disease fungus, work in weakened trees; **Red Elm Bark Beetle; Black Elm Snout Beetle; Northern Brenthian** (beetle).

Japanese Beetle—may chew leaves to lace; **June Beetle; Rose Chafer; Carrot Beetle; Grape Flea Beetle; Locust Leaf Beetle; Apple Flea Weevil.**

Fall and Spring Cankerworms—may defoliate some seasons; important; **Eastern Tent Caterpillar; Mourning-cloak Butterfly; Hemlock Looper; Omnivorous Looper; Fruit Tree Leaf Roller; Elm Spanworm; Limetree Spanworm; Fall Webworm.**

Elm Sawfly; Elm Leaf Miner; Elm Casebearer; Black-horned Tree Cricket.

Brown-tail Moth; Cecropia Moth; Gypsy Moth; Io Moth; Polyphemus Moth; White-lined Sphinx; White-marked Tussock Moth.

Flatheaded Apple Tree Borer—injurious to newly transplanted trees; **Pacific Flatheaded Borer; Elm Borer; Carpenter Worm; Leopard**

Moth; Azalea Stem Borer; Brown Wood Borer; Pigeon Tremex; Shot-hole Borer; Twig Pruner.

Elm Scurfy Scale—female pear-shaped, white to gray; may kill branches or young trees; **European Elm Scale**—yellow foliage, early drop, much honeydew; **Scurfy Scale; Oystershell Scale; Calico Scale; Camphor Scale; Citricola Scale; Cottony Maple Scale; European Fruit Lecanium; Lecanium Scale; Putnam Scale.**

Woolly Apple Aphid and **Woolly Elm Aphid**—leaves curling around rosy lice covered with white filaments; **Elm Cockscomb Gall Aphid.**

Alder Lacebug and **Elm Lacebug**—gray flecking of leaves which may turn brown.

Virginia Creeper Leafhopper; Buffalo Treehopper.

Root-knot Nematode; Common Red Spider; Avocado Red Mite.

Despite the appallingly long list of pests, most important elm insects can be taken care of by a dormant oil spray, where scale insects are serious, and by 1 or 2 foliage sprays with lead arsenate, timed for the most serious chewing insects in particular localities, and a thorough cleanup program to remove dead and dying wood.

Endive (*Cichorium*)

Bean Aphid—black; **Pea Aphid**—large, green.

Root-knot Nematode.

English Ivy (*Hedera helix*)

Bean Aphid—black, common on ivy indoors and out; **Ivy Aphid; Green Peach Aphid.**

Common Red Spider—mealy coating; leaves turn grayish; exceedingly common on house ivies that are not bathed frequently.

Oleander Scale—yellow, flat, prevalent; **Dictyospermum Scale; Florida Red Scale; Greedy Scale**—gray, convex; **Olive Parlatoria; Peach Scale; Pineapple Scale; Soft Scale**—brown, soft, convex.

Citrus Mealybug; Grape Mealybug; Mexican Mealybug—white, cottony bodies also common on neglected house ivies and outdoors in warm climates.

Citrus Whitefly.

Omnivorous Looper; Puss Caterpillar; Blister Beetles; Celery Leaf Tier.

Erigeron

Aster Root Aphid; Leaf Curl Plum Aphid.

Eriophyllum

Yucca Mealybug.

Erythronium (Dog-tooth Violet or Trout Lily)

Green Peach Aphid.

Eucalyptus

Black Scale; California Red Scale; Florida Red Scale; Greedy Scale; Oleander Scale; Purple Scale; San Jose Scale.

Cowpea Aphid; Long-tailed Mealybug; Avocado Mite; Southern Red Mite.

California Prionus—root borer; **Pacific Flatheaded Borer.**

Omnivorous Looper; Orange Tortrix—caterpillar sometimes feeding in rolled leaves; **California Oak Worm**—rarely injurious.

Eugenia

Florida Red Scale; Citrophilus Mealybug.

Euonymus

Euonymus Scale—males narrow, white, conspicuous; females brown; very common and injurious with vines yellowing, dying back; **California Red Scale; Chaff Scale; Cottony Maple Scale; Greedy Scale; Florida Red Scale; Florida Wax Scale; Dictyospermum Scale.**

Bean Aphid—black; prevalent; **Ivy Aphid; Green Peach Aphid.**

Greenhouse Thrips.

Lilac Leaf Miner—infrequent; tan blotches in leaves.

Eupatorium (Mistflower)

Red lice, probably **Goldenglow Aphid**—common, on stems; **Leaf Curl Plum Aphid**—in West; **Barnacle Scale.**

Chrysanthemum Leaf Miner—white serpentine mines in leaves; prevalent.

Fern

Fern Scale—white; **Hemispherical Scale**—brown; **Florida Wax Scale; Green Shield Scale; Oleander Scale**—pale yellow, round, flat, frequently present; **Soft Scale**—brown; also common; **Tea Scale**—white, filamentous.

Leaf Nematode—black or brown bands across leaves.

Common Red Spider; Onion Thrips; Greenhouse Thrips.

Fern Whitefly; Citrus Whitefly; Citrus Mealybug; Long-tailed Mealybug.

Fern Aphid—black; **Lantana Aphid**—dark with white fringe.

Florida Fern Caterpillar—green to black; feeds at night, may strip foliage; **Orange Tortrix**—may roll leaves; **Fern Moth**—green or brownish-red caterpillar; **Yellow Woolly Bear.**

Black Vine Weevil—grubs work at roots; **Cutworms.**
Japanese Beetle—very fond of some species.
Fern Snail—eats parenchyma tissue from lower leaf surface.

Ficus or Fig Vine

Chaff Scale; Florida Wax Scale; Lesser Snow Scale; Green Shield Scale; Mining Scale; Citrus Whitefly.

Fig (*Ficus carica*)

Citrophilus Mealybug; Long-tailed Mealybug—common white, fuzzy bodies in leaf axils, on twigs, and large branches; **Pacific Mite.**
Black Scale; California Red Scale; Camphor Scale; Cottony-cushion Scale; Mediterranean Fig Scale—oyster-shaped, purple to brown; **Florida Red Scale; Greedy Scale; Mining Scale; Oystershell Scale; San Jose Scale; Soft Scale; Tea Scale.**
Root-knot Nematode—swellings on roots; becoming more prevalent.

Fig Beetle and **Green June Beetle**—both bronzy-green.
Branch and Twig Borer—black and brown beetle burrowing into twig crotches.

A dormant oil spray in winter followed by summer sprays with Lethane or Loro is satisfactory in some states.

Fir (*Abies*)

Spruce Budworm—leaves webbed together; **Spruce Sawfly**—greenish worm with black spots; eats needles; **Hemlock Looper**—also green caterpillar with black spots; **Bagworm; Spotted Tussock Moth.**
Fir Flatheaded Borer—this is the balsam bark beetle.

Balsam Twig Aphid—white, cottony on needles which may turn brown.
Spruce Mite—needles cobwebby; **Oystershell Scale; Pine Needle Scale.**

Forget-Me-Not (*Myosotis*)

Forget-me-not Aphid; Green Peach Aphid.

Painted Beauty—purple, yellow, and green caterpillars.
Flea Beetle—probably potato species; small, black; very common, making minute shot holes in foliage in early spring; **Celery Leaf Tier.**

A combination spray, such as Triogen, made up for roses, can be used on edging forget-me-nots at the same time and will control all these pests.

Forsythia

Usually free from insect pests. The **Four-lined Plant Bug** sometimes punctures leaves, resulting in small tan circles.

Foxglove (Digitalis)

Foxglove Aphid; Lily Aphid; Citrophilus Mealybug.
Stem and Bulb Nematode—angular spots in leaves; infrequent.

Asiatic Garden Beetle; Japanese Beetle; Rose Chafer.

Freesia

Bulb Mite—in rotting bulbs; **Root-knot Nematode.**
Gladiolus Thrips—streaking blossoms, silvering foliage; **Lily Aphid.**

Fuchsia

Greenhouse Whitefly—exceedingly prevalent; **Iris Whitefly.**
Citrus Mealybug; Long-tailed Mealybug—often present; **Greenhouse Thrips.**
Common Red Spider; Privet Mite; Cyclamen Mite; Broad Mite.
Potato Aphid—pink or green; **Lily Aphid**—black or yellow; **Ornate Aphid**—green; not described in other section; common near San Francisco.
Black Scale; California Red Scale; Greedy Scale.

Fuller Rose Beetle; Strawberry Flea Beetle; White-lined Sphinx (moth).

Gaillardia

Four-lined Plant Bug—tan depressed spots in leaves.
Six-spotted Leafhopper—transmits aster yellows; **Onion Thrips.**

Asiatic Garden Beetle; Japanese Beetle.
Stalk Borer—brown, white-striped caterpillar in stalk; **Wireworms.**

Galtonia

Narcissus Bulb Fly.

Gardenia (Cape-jasmine)

Citrus Mealybug; Long-tailed Mealybug—cottony oval insects in axils; very common; **Citrus Whitefly**—prevalent in South.
Banded Greenhouse Thrips; Greenhouse Orthezia—scale-like with wax.
Root-knot Nematode—galls on roots, sometimes showing in discolored leaves.
Florida Wax Scale; Green Shield Scale; Soft Scale.
Fuller Rose Beetle—weevil notches leaves at night.

Garlic

Stem and Bulb Nematode.

GERANIUM (*Pelargonium*)

Greenhouse Whitefly—practically inevitable on geranium; leaves turn yellow and drop; **Citrus Mealybug; Mexican Mealybug**—also common.

Cyclamen Mite—young leaves curl; **Broad Mite; Common Red Spider.**

Green Peach Aphid; Geranium Aphid and other species occasionally present.

Cottony-cushion Scale; Lesser Snow Scale.

Celery Leaf Tier; Oblique-banded Leaf Roller; Tobacco Webworm—all web leaves.

Fuller Rose Beetle; Black Vine Weevil; Imported Long-horned Weevil.

Fall Cankerworm; Omnivorous Looper; Corn Earworm; Cabbage Looper.

Greenhouse Slug; Spotted Slug; Subterranean Termite.

GERBERA

Cyclamen Mite; Broad Mite.

GERMAN IVY (*Senecio*)

Melon Aphid.

GINKGO

Grape Mealybug; Peach Scale.

Omnivorous Looper.

GINSENG

Oystershell Scale.

GLADIOLUS

Gladiolus Thrips—most important insect; leaves and flowers streaked, flowers deformed, plants stunted; **Western Flower Thrips; Banded Greenhouse Thrips.**

Potato Aphid; Melon Aphid; Tulip Bulb Aphid—in corms.

Bulb Mite—in corms; **Grape Mealybug**—in depressions in corms.

Tarnished Plant Bug; Red-banded Leafhopper; Latania Scale.

Corn Earworm; Zebra Caterpillar; Cutworms.

Imported Long-horned Weevil; June Beetle; Wireworms.

GLOBE THISTLE (*Echinops*)

Green Peach Aphid—leaves curl down.

Four-lined Plant Bug—small, circular; tan spots in leaves.

GLOXINIA

Greenhouse Thrips; Onion Thrips.
Green Peach Aphid; Lily Aphid.

Black Vine Weevil—grubs work at roots.

GOLDEN-CHAIN (*Laburnum*)

Laburnum Aphid—infests end of branches which may die; **Bean Aphid.**
Grape Mealybug.

GOLDENGLOW

Goldenglow Aphid—bright red on stems; very common.

Goldenglow Sawfly—gray worm with dark spots; sometimes defoliates.
Burdock Borer.

GOLDENROD

Goldenrod Lacebug.

Orange Tortrix (caterpillar).

GOOSEBERRY

(See also Currant)

Currant Aphid—crinkled leaves; **Gooseberry Aphid.**
Four-lined Plant Bug; Grape Mealybug.
Oystershell Scale; Peach Scale; Putnam Scale; San Jose Scale; Scurfy Scale; Cottony Maple Scale; European Fruit Lecanium.

Imported Currant Worm—green, black-spotted larvae may chew all leaves; **Currant Spanworm; Fruit Tree Leaf Roller; Oblique-banded Leaf Roller; White-lined Sphinx** (moth); **Yellow Woolly Bear** (caterpillar).
Currant Fruitfly; Gooseberry Fruitworm—maggots in berries.
Imbricated Snout Beetle.
Currant Borer; Pacific Flatheaded Borer.

GOURD

Melon Aphid; Squash Bug—shield-shaped brownish bug.
Greenhouse Whitefly—often abundant on underside of leaves.

Squash Borer—vine wilts; **Striped Cucumber Beetle; Spotted Cucumber Beetle.**

GRAPE

Japanese Beetle—exceedingly prevalent on foliage, leaves nothing but veins; **Rose Chafer; Grape Colaspis; Bumble Flower Beetle; Darkling**

Beetles; Fig Beetle; Green June Beetle; Rose Leaf Beetle; Spotted Grapevine Beetle; Grape Bud Beetle; Grape and **Western Grape Rootworms**—chains of holes in leaves; **Strawberry Rootworm.**

Grape Berry Moth—clusters webbed together, wormy berries; **Grape Curculio; Grape Plume Moth; Achemon Sphinx; White-lined Sphinx** (moth).

Grape Flea Beetle; Steel-blue Flea Beetle.

Eight-spotted Forester (caterpillar); **Yellow Woolly Bear; Corn Earworm; Grape Leaf Folder; Grape Leaf Skeletonizer; Western Grape Skeletonizer.**

Grape Blossom Midge; Grapevine Tomato Gall; Black-horned Tree Cricket.

Grasshoppers; Armyworms; Cutworms.

Grape Root Borer; Branch and Twig Borer; Broad-necked Root Borer.

Grape Phylloxera (aphid)—galls on roots, leaves; **Grapevine Aphid.**

Grape Leafhopper; Virginia Creeper Leafhopper; Three-banded Leafhopper.

Grape Mealybug; Ground Mealybug; Long-tailed Mealybug; Boxelder Bug; Harlequin Bug.

Grape Thrips; Citrus Thrips; Western Flower Thrips; Pear Thrips.

Greenhouse Whitefly; Grape Whitefly; Woolly Whitefly; Pacific Mite—turns leaves red, defoliates.

Grape Scale—round, gray to brown, on old canes; **Black Scale; California Red Scale; Camphor Scale; Cottony-cushion Scale; Cottony Maple Scale; European Fruit Lecanium; Florida Red Scale; Greedy Scale; Lesser Snow Scale; Obscure Scale; Olive Parlatoria; Oystershell Scale; Peach Scale; Walnut Scale; White Peach Scale.**

Root-knot Nematode; Stem and Bulb Nematode.

Many eastern gardeners get fairly good grapes merely by controlling Japanese beetles in midsummer, but where black rot and fruit insects are a problem the following is a tentative schedule, subject to advice from your local county agent.

1. *Shortly Before Blossoms Open,* to control mildew, black rot, flea beetles, curculio.

   2¾ tablespoons lead arsenate
   1 gallon 3–3–50 bordeaux mixture.

2. *Just After Fruit Is Set,* to control berry moth and rootworm beetles.

   Same as Number 1.

3. *Ten to Fourteen Days After Number 2,* to control black rot, mildew, berry moth, and rootworms.

   Same as Number 1.

4. *When Japanese Beetles Appear*

Special rotenone spray, such as Japellent or Jap-Ro-Cide, repeated weekly.

If rose chafers are serious, spray with strong lead arsenate, using 4 tablespoons per gallon plus ⅓ cup molasses.

Add nicotine sulfate to any spray to control leafhoppers.

Sulfur dust helps in controlling mites prevalent on grapes in the West and South, but consult your experiment station for a specific schedule.

Grapefruit

(See also Citrus)

Citrus Rust Mite; Citrus Red Mite; Citrus Thrips; Citrus Mealybug.

Black Scale; California Red Scale; Cottony-cushion Scale; Hemispherical Scale; Olive Parlatoria; Soft Scale.

Fuller Rose Beetle—margins of leaves notched; **Orange Tortrix** (caterpillar).

Grass

(See Lawns)

Groundcherry (*Physalis*)

Potato Aphid—pink or green.

Potato Flea Beetle; Tobacco Flea Beetle.

Tobacco Budworm; Tomato Hornworm.

Guava

Black Scale; Barnacle Scale; Chaff Scale; Florida Red Scale; Greedy Scale; Hemispherical Scale; Florida Wax Scale; Green Shield Scale; Soft Scale.

Long-tailed Mealybug; Greenhouse Thrips.

Mexican Fruitfly—in Texas; **Subterranean Termites.**

Gypsophila

Six-spotted Leafhopper.

Hackberry (*Celtis*)

Hackberry Galls—witches' brooms, excessive twiggy growth due to a mite; and other twig, bud, and leaf galls.

Mulberry Whitefly; Blueberry Spittle Bug.

Camphor Scale; Citricola Scale; Cottony-cushion Scale; Cottony Maple Scale; Lesser Snow Scale; Oystershell Scale; Putnam Scale; San Jose Scale.

Oriental Moth; Puss Caterpillar; Mourning Cloak (caterpillar).
Painted Hickory Borer; Twig Pruner.

HAWTHORN or THORN (*Crataegus*)

Hawthorn Lacebug—leaves lose color, brown flecks on underside; common; **Apple Redbug; Lightning Leafhopper**—white, fluffy; **Common Red Spider.**

Woolly Hawthorn Aphid and **Woolly Apple Aphid**—white masses on branches and foliage; **Apple Aphid; Apple Grain Aphid; Clover Aphid.**

Cottony Maple Scale; Barnacle Scale; European Fruit Lecanium; Florida Wax Scale; Lecanium Scale; Putnam Scale; Scurfy Scale; Soft Scale.

Apple and Thorn Skeletonizer; Pear Slug (sawfly); **Cankerworms.**

Eastern Tent Caterpillar—common on hawthorn; **Forest Tent Caterpillar; Coast Tent Caterpillar; Red-humped Caterpillar; Variable Oakleaf Caterpillar; Oblique-banded Leaf Roller; Western Tussock Moth; Gypsy Moth; Walnut Caterpillar.**

Japanese Beetle; Great Elm Leaf Beetle.

Pear Borer; Roundheaded Apple Tree Borer; Flatheaded Apple Tree Borer; Shot-hole Borer.

HAZEL, HAZELNUT, or FILBERT (*Corylus*)

Hazel Bud Gall; Filbert Bud Mite, or **Big-bud.**
Alder Lacebug; Aphids; Whiteflies.
European Fruit Lecanium; Oystershell Scale.

California Tent Caterpillar; Yellow-necked Caterpillar; Oblique-banded Leaf Roller.

Hazelnut Weevil; Apple Flea Weevil.

HEATH (*Erica*)

Greedy Scale; Oystershell Scale; Oleander Scale.

HEATHER (*Calluna*)

Oystershell Scale; Common Red Spider.

Japanese Beetle.

HELENIUM

Helenium Snout Beetle—feeds on new growth.

HELIOPSIS

Four-lined Plant Bug.

Heliotrope

Greenhouse Whitefly—very common, even in outdoor gardens; **Common Red Spider.**

Citrus Mealybug; Citrophilus Mealybug; Greenhouse Orthezia.

Green Peach Aphid; Lily Aphid; and other species.

Greenhouse Leaf Tier; Subterranean Termites.

Hemlock

Hemlock Scale—gray, circular, leaves turn yellow; **Pine Needle Scale.**

Spruce Mite—grayish webs over and between needles.

Hemlock Borer—destructive; larva is flatheaded; beetle bronze with white spots; **Fir Flatheaded Borer.**

Bagworm; Hemlock Looper; Hemlock Sawfly; Spruce Budworm; Spruce Leaf Miner; Gypsy Moth.

Hibiscus (including Rose Mallow)

California Red Scale; Lesser Snow Scale; Green Shield Scale; Mining Scale; Pineapple Scale; San Jose Scale.

Greenhouse Whitefly; Melon Aphid.

Japanese Beetle—numerous on mallow flowers; **Fuller Rose Beetle; Abutilon Moth**—green caterpillar; **Corn Earworm.**

Hickory

Hickory Aphid—large, gray, and black; **Hickory Gall** (aphid).

Periodical Cicada; Two-marked Treehopper.

Grape Scale; Obscure Scale; Putnam Scale.

Hickory Bark Beetle—quite destructive; **Hickory Saperda; Hickory Snout Beetle; Hickory Timber Beetle; June Beetle.**

Painted Hickory Borer; Pecan Carpenter Worm; Tiger Hickory Borer; Flatheaded Apple Tree Borer; Brown Wood Borer; Twig Pruner.

Pecan Weevil; Hickory Nut Curculio; New York Weevil.

Walnut Caterpillar—black with white hairs; may strip foliage; **Hickory Horned Devil; Red-humped Caterpillar; Yellow-necked Caterpillar; Fall Webworm; Butternut Woolly Worm; Walkingstick.**

Hickory Tussock Moth; Imperial Moth; Io Moth; Luna Moth; Oriental Moth.

Holly (*Ilex*)

Holly Leaf Miner—blotch and serpentine mines in leaves, very disfiguring, prevalent; **Potato Flea Beetle.**

Oystershell Scale; Black Scale; California Red Scale; Greedy Scale; Soft Scale; Peach Scale.

Comstock Mealybug; Mulberry Whitefly.

HOLLYHOCK (*Althea rosea*)

Japanese Beetle—very fond of flowers; **Spotted Slug**—very fond of foliage; **Rose Chafer.**

Abutilon Moth; Painted Lady and **Painted Beauty** (caterpillars); **Yellow Woolly Bear.**

Burdock Borer; Stalk Borer.

Common Red Spider—leaves yellow, webby; common in sheltered locations; **Hollyhock Thrips; Gladiolus Thrips.**

Red-banded Mealybug; Mexican Mealybug; Lesser Snow Scale.

Root-knot Nematode.

HONEY LOCUST (*Gleditsia*)

Cottony Maple Scale; Black Scale; Greenhouse Whitefly.

Pod Galls—very common but not serious, not described in Bug section.

Walnut Caterpillar; Oriental Moth.

HONEYSUCKLE (*Lonicera*)

Honeysuckle Aphid—green, and other species; **Woolly Honeysuckle Aphid.**

Long-tailed Mealybug; Greenhouse Whitefly; Iris Whitefly.

Oystershell Scale; San Jose Scale; Greedy Scale.

Four-lined Plant Bug.

European Honeysuckle Leaf Roller; Omnivorous Looper; Honeysuckle Sawflies.

Snowberry Clear-wing—green to brown hornworm caterpillar; **White-lined Sphinx** (moth).

HORNBEAM (*Carpinus*)

Maple Phenacoccus (scale).

HORSECHESTNUT

Japanese Beetle—very destructive; leaves like lace, fall; **Potato Flea Beetle.**

White-marked Tussock Moth—rather common black caterpillar with white tufts; feeds on foliage; **Elm Spanworm; Oblique-banded Leaf Roller; Bagworm.**

Flatheaded Apple Tree Borer.

Comstock Mealybug.

Oystershell Scale; Scurfy Scale; Lecanium Scale; Putnam Scale; English Walnut Scale; Cottony Maple Scale; Maple Phenacoccus.

Horseradish

Horseradish Flea Beetle; Western Black Flea Beetle.

Imported Cabbage Worm; Cabbage Looper; Diamondback Moth; Cabbage Webworm; Cabbage Curculio.

Harlequin Bug.

Huckleberry

Blueberry Maggot; Red-humped Caterpillar; Currant Spanworm.

Hyacinth

Narcissus Bulb Fly; Lesser Bulb Fly—large white maggots in rotting bulbs; **Yellow Woolly Bear** (Caterpillar.)

Bulb Mite; Stem and Bulb Nematode.

Hydrangea

Lily Aphid; Melon Aphid; Common Red Spider; Banded Greenhouse Thrips.

Tarnished Plant Bug.

Hydrangea Leaf Tier—leaves sewed together over flower bud; **Rose Chafer.**

Hymenocallis (Spider Lily)

Banded Greenhouse Thrips; Lesser Snow Scale.

Convict Caterpillar.

Hyssop

Black Araucaria Scale.

Iceplant (*Mesembryanthemum* or *Cryophytum*)

Yucca Mealybug; Lesser Snow Scale.

Impatiens

(See Balsam, Garden)

Iris

Iris Borer—chief iris pest, destructive in its own right, producing ragged leaves, hollow rhizomes, and as a carrier of soft-rot bacteria; **Burdock Borer.**

Spotted Slug and others—hide at base of leaves.
Verbena Moth—green caterpillars feed on seedpod; **Zebra Caterpillar.**
Lesser Bulb Fly.

Iris Thrips—more prevalent on Japanese iris, russeting foliage, stunting growth; **Florida Flower Thrips; Gladiolus Thrips.**
Tulip Bulb Aphid—white cottony root aphid; **Lily Aphid; Potato Aphid.**
Florida Red Scale; Stem and Bulb Nematode.

Ironwood

Melon Aphid; Cottony-cushion Scale.

Ixora

Florida Wax Scale; Green Shield Scale.

Jacaranda

Greenhouse Orthezia.

Japanese Quince (*Chaenomeles lagenaria*)

San Jose Scale; Scurfy Scale; Black Scale; Peach Scale.
Melon Aphid; Hawthorn Lacebug; Grape Mealybug.

Japanese Beetle.

Japanese Cherry (*Prunus serrulata, P. yedoensis*)

(See also Cherry)

Waterlily Aphid; Lightning Leafhopper.
West Indian Peach Scale.

Eastern Tent Caterpillar, Saddleback and other slug **Caterpillars; Cankerworms.**

Jasmine or Jessamine (*Jasminum*)

Citrus Whitefly.
Black Scale; Purple Scale; California Red Scale; Camphor Scale; Barnacle Scale; Chaff Scale; Florida Red Scale; Green Shield Scale; Mining Scale; Olive Parlatoria; Soft Scale.

Jerusalemcherry (*Solanum pseudocapsicum*)

Potato Aphid—pink or green.
Onion Thrips; Flower Thrips; Greenhouse Whitefly.

Orange Tortrix—leaf rolling caterpillar.

Jobs tears (*Coix lacryma-jobi*)

Orange Tortrix.

Judas Tree

(See Redbud)

Juniper (Red Cedar and other species)

Juniper Scale—small, round, white, foliage yellowing; very common.
Red Cedar Aphid; Taxus Mealybug—occasional pest.
Common Red Spider and **Spruce Mite**—foliage webby, grayish, unhealthy.

Bagworm—bags attached to twigs; rather frequent.
Juniper Webworm—tips of branches webbed together; **Imperial Moth.**
Red Cedar Bark Beetle; Deodar Weevil.

Use oil sprays cautiously on juniper species where needles are so cupped that they tend to hold the oil. Substitute lime-sulfur for a dormant spray where possible.

Kale

(See also Cabbage)

Cabbage Aphid; Turnip Aphid.

Cabbage Looper; Imported Cabbage Worm; Diamondback Moth.
Cabbage Webworm; Celery Leaf Tier.

Kalmia

(See Mountain Laurel)

Kerria

Japanese Beetle—prevalent.

Kohl-rabi

(See also Cabbage)

Cabbage Aphid; Turnip Aphid; Harlequin Bug.

Cabbage Looper; Imported Cabbage Worm.

Kudzu Vine

Velvetbean Caterpillar; Japanese Beetle.

Kumquat

(See also Citrus)

Citrus Thrips; Citrus Rust Mite.

Lantana

Citrus Mealybug; Mexican Mealybug; Yucca Mealybug—white cottony sacs.

Greenhouse Whitefly—tiny white moths on underside of leaves.
Lantana Aphid—dark with white fringe; **Greenhouse Orthezia.**
Leaf Nematode—dark blotches in leaves.
Cyclamen Mite; Broad Mite.

Orange Tortrix; Celery Leaf Tier.

LARCH

Larch Sawfly—live green larvae may strip trees; **Redheaded Pine Sawfly.**
Larch Casebearer—leaves mined, used as cases; **Bagworm**—may seriously defoliate.
Spruce Budmoth; Gypsy Moth; White-marked Tussock Moth.
Eastern Larch Beetle; Pales Weevil; Douglas-fir Beetle; Douglas-fir Engraver; Japanese Beetle.
Fir Flatheaded Borer.

Larch Woolly Aphid.

LARKSPUR (Annual Delphinium)

Goldenglow Aphid—red lice common in flower buds.
Cyclamen Mite—occasionally deforms; **Ground Mealybug.**

Larkspur Leaf Miner; Stalk Borer.

LAUREL

(See Bay, California Laurel, Cherry Laurel, Mountain Laurel)

LAURESTINUS (*Viburnum tinus*)

Greenhouse Thrips.

LAVATERA

Greedy Scale.

LAVENDER

Four-lined Plant Bug—depressed round spots in new leaves.

Orange Tortrix; Yellow Woolly Bear; other caterpillars.

LAWNS

Hairy Chinch Bug—lawn turns brown in small to large areas; serious injury.
Bluegrass Aphid; Leafhoppers.

Japanese Beetle—grubs work on roots, grass rolls back like a carpet; **Asiatic Garden Beetle; June Beetle; European Chafer.**

Sod Webworms—larvae-like cutworms, have nests lined with silk; **Cutworms; Armyworms; Grasshoppers; Slugs; Wireworms.**

Ants, Argentine, Cornfield and others—mounds in lawns.

Crawfish—mounds in lawns near water; **Mole Crickets; Moles; Dogs.**

Lemon

(See also Citrus)

Citrus Red Mite; Citrus Rust Mite; Citrus Thrips.

Long-tailed Mealybug; Grape Mealybug; Yucca Mealybug.

Black Scale; California Red Scale; Cottony-cushion Scale; Dictyospermum Scale; Hemispherical Scale; Soft Scale.

Fuller Rose Beetle; Omnivorous Looper; Subterranean Termite.

Lettuce

Green Peach Aphid; Turnip Aphid; Goldenglow Aphid.

Greenhouse Whitefly.

Pitted Lygaeid—southern bug resembling a chinch bug; **Harlequin Bug; Tarnished Plant Bug.**

Potato Leafhopper; Garden Fleahopper; Root-knot Nematode.

Potato Flea Beetle; Pale-striped Flea Beetle.

Celery Leaf Tier; Cabbage Looper; Celery Looper; Imported Cabbage Worm; Corn Earworm; Cutworms.

Garden Slugs; Garden Centipede (symphilid) ; **Millipedes.**

Lignum-vitae (*Guaiacum*)

Barnacle Scale; Florida Wax Scale.

Lilac (Syringa)

Oystershell Scale—may almost completely encrust bark on some branches; almost always present; **San Jose Scale; White Peach Scale; Cottony Maple Scale; Euonymus Scale; Olive Parlatoria.**

Citrus Whitefly.

Lilac Borer—very common; holes in trunk with protruding sawdust.

Giant Hornet—tears off bark.

Lilac Leaf Miner—tan to brown blotches in leaves.

Rhinoceros Beetle—in some sections feeds on roots, kills bushes.

Hickory Horned Devil (caterpillar) ; **Oblique-banded Leaf Roller.**

Cynthia Moth; Leopard Moth; Polyphemus Moth; Promethea Moth.

White Snail—may feed on leaves.

LILY

Melon Aphid—dark green to brown, transmits mosaic; **Lily Aphids**—black and yellow; **Green Peach Aphid; Foxglove Aphid.**
Lily Thrips; Bulb Mite.

Narcissus Bulb Fly—large white maggot in rotting bulb.
Fuller Rose Beetle; Yellow Woolly Bear (caterpillar).
Stalk Borer.

LILY-OF-THE-VALLEY (*Convallaria*)

Root-knot Nematode—swellings on roots.

Lily-of-the-Valley Weevil—curious notches in leaves.

LIME
(See also Citrus)

Citrus Rust Mite; Citrus Thrips; Greenhouse Thrips.
Yucca Mealybug; Western Leaf-footed Bug.
Cottony-cushion Scale; Lecanium Scale; Oystershell Scale.

LINDEN or LIMETREE or BASSWOOD (*Tilia*)

Japanese Beetle—very fond of foliage; **Linden Leaf Beetle**—beautifully marked with green; **Bagworm.**
Fall Cankerworm; Variable Oak-leaf Caterpillar; Elm Spanworm or **Snow-white Linden Moth; Limetree Spanworm; Elm Sawfly.**
Basswood Leaf Miner; Basswood Leaf Roller; Oblique-banded Leaf Roller.
White-marked Tussock Moth; Cecropia Moth; Cynthia Moth; Gypsy Moth.
Flatheaded Apple Tree Borer; Brown Wood Borer; Linden Borer.

Cottony Maple Scale; Oystershell Scale; San Jose Scale; Putnam Scale; European Fruit Lecanium; Terrapin Scale; Tuliptree Scale; Walnut Scale; Willow Scale.
Linden Aphid—yellow and black; often abundant.
Mulberry Whitefly—dark nymph with white fringe.
Walnut Lacebug; Taxus Mealybug; Green Stinkbug.

LOBELIA

Negro Bug; Six-spotted Leafhopper; Root-knot Nematode.

Celery Leaf Tier.

Locust (*Robinia*)

Locust Borer—often serious, young trees may be killed; **Carpenter Worm; Locust Twig Borer; Painted Hickory Borer; Twig Pruner; Brown Wood Borer.**

Locust Leaf Beetle; Sweetpotato Leaf Beetle—leaves skeletonized.

Locust Leaf Miner; Fruit Tree Leaf Roller.

Red-humped Caterpillar; Velvetbean Caterpillar; Silver-spotted Skipper; Walkingstick; Bagworm.

Black Scale; Cottony-cushion Scale; Cottony Maple Scale; Oystershell Scale; Putnam Scale; San Jose Scale; Soft Scale; Walnut Scale.

Loganberry

(See also Raspberry)

Raspberry Fruitworm; Raspberry Sawfly; Raspberry Cane Maggot; Strawberry Root Weevil.

Fruit Tree Leaf Roller; Oblique-banded Leaf Roller.

Fuller Rose Beetle.

Snowy Tree Cricket; Black-horned Tree Cricket.

Rose Scale.

Greenhouse Whitefly; Glacial Whitefly.

London Plane

(See Sycamore)

Loquat

Florida Wax Scale; Olive Parlatoria; San Jose Scale.

Southern Red Mite; Melon Aphid; Green Apple Aphid.

Harlequin Bug; Squash Bug; Root-knot Nematode.

Codling Moth; Western Striped and Spotted Cucumber Beetle; Flea Beetles.

Pacific Flatheaded Borer; Shot-hole Borer.

Lupine

Lupine Aphid—green with white wax; may be numerous.

Four-lined Plant Bug; Greenhouse Whitefly.

Lupine Weevil—eats half-moons out of leaves.

Madrona or Strawberry Tree (*Arbutus*)

Black Scale; Greedy Scale; Soft Scale.

Pear Thrips; Madrona Thrips; Iridescent Whitefly.

California Tent Caterpillar.
California Prionus (borer).

MAGNOLIA

Magnolia Scale—soft, brown, convex, covered with white wax; **Tuliptree Scale; Cottony-cushion Scale; Soft Scale; Black Scale; Chaff Scale; European Fruit Lecanium; Glover Scale; Greedy Scale; Florida Wax Scale; Oleander Scale; Purple Scale.**
Comstock Mealybug; Citrus Whitefly.

Omnivorous Looper.

MAHONIA (Oregon Grape)

Barberry Aphid; Inconspicuous Whitefly.
Greedy Scale.

MALLOW, ROSE
(See Hibiscus)

MALVA (Marshmallow)

Painted Beauty; Painted Lady—caterpillars.

MANGEL

Spinach Leaf Miner.

MANGO

California Red Scale; Chaff Scale; Florida Red Scale; Florida Wax Scale; Glover Scale; Lesser Snow Scale; Green Shield Scale.
Long-tailed Mealybug; Greenhouse Thrips; Avocado Red Mite.

Mexican Fruitfly—Texas only.

MANZANITA

Crown Whitefly; Inconspicuous Whitefly; Iridescent Whitefly.
Soft Scale; Greedy Scale.
Manzanita Leaf-gall Aphid.

Western Tussock Moth.

MAPLE

Norway Maple Aphid—perhaps most annoying of all maple pests because of the honeydew dropped on automobiles; **Maple Aphid; Sycamore Aphids; Woolly Alder Aphid.** (Japanese Maple is particularly subject to aphid infestations.)

Cottony Maple Scale—widely present; **Maple Phenacoccus; Black Scale; Calico Scale; Chaff Scale; Cottony-cushion Scale; Florida Wax Scale; Gloomy Scale; Greedy Scale; Japanese Scale; Lecanium Scale; Obscure Scale; Oystershell Scale; Terrapin Scale; Walnut Scale.**

Norway Maple Leafhopper; Grape Leafhopper; Bean Thrips.

Comstock Mealybug; Taxus Mealybug; Boxelder Bug; Green Stink-bug.

Mulberry Whitefly; Inconspicuous Whitefly.

Maple Bladder Gall; Maple Leaf Gall; Maple Spindle Gall; Maple Gouty Vein Gall.

Sugar Maple Borer—serious; **Carpenter Worm; Leopard Moth; Brown Wood Borer; Gall-making Maple Borer; Maple Callus Borer; Maple Petiole Borer; Pigeon Tremex; Twig Pruner; Flatheaded Apple Tree Borer; Pacific Flatheaded Borer.**

Green-striped Maple Worm; Cankerworms; Eastern Tent Caterpillar; Forest Tent Caterpillar; Hemlock Looper; Omnivorous Looper; Saddled Prominent (caterpillar).

Brown-tail Moth; Cecropia Moth; Io Moth; Pale Tussock Moth; Polyphemus Moth; White-marked Tussock Moth; Oriental Moth.

Maple Leaf Cutter; Maple Trumpet Skeletonizer; Elm Sawfly; Elm Spanworm.

Bagworm; Blackhorned Tree Cricket.

Despite the long list of possible pests most maples get along very nicely with 1 or 2 sprays a season—sometimes none at all. Some maple varieties, particularly sugar maples, are subject to injury from oil sprays so that often summer applications of nicotine sulfate are used instead of dormant treatments.

Marigold

Japanese Beetle—extremely fond of foliage and flowers; must be sprayed continuously during season.

Greenhouse Leaf Tier; Greenhouse Slug; Spotted Slug.

Cyclamen Mite; Broad Mite—sometimes in greenhouses; rare outdoors.

Tarnished Plant Bug; Potato Leafhopper.

Marguerite

(See also Chrysanthemum)

Chrysanthemum Leaf Miner or **Marguerite Fly.**

Cyclamen Mite; Broad Mite, Ground Mealybug.

Leaf Curl Plum Aphid.

MATRIMONY VINE (*Lychium*)

Lily Aphid, and other species.
Leaf Blister Galls—not described in other section; no control.

Potato Tuber Moth.

MELON

(See also Cantaloupe, Watermelon)

Melon Aphid—dark green to brown to black, carries mosaic virus, curls foliage; widely prevalent; injurious.
Beet Leafhopper—transmits curly top in West.
Squash Bug—large, brown, shield-shaped bug; **Root-knot Nematode.**

Onion Thrips; Western Flower Thrips; Greenhouse Whitefly; Common Red Spider.

Squash Borer—vines wilt.
Melon Worm; Pickleworm—most serious in South.
Striped Cucumber Beetle; Spotted Cucumber Beetle; Western Striped Cucumber Beetle; Squash Beetle; Striped Blister Beetle; Imbricated Snout Beetle; Fig Beetle.
Pale-striped Flea Beetle; Potato Flea Beetle.
Yellow Woolly Bear (caterpillar); **Millipedes**—get in fruit on ground.

Start melons like cucumbers under protective Hotkaps or wire screens, following up with rotenone, or sometimes cryolite. Never use sulfur on melons.

MIGNONETTE (*Reseda*)

Six-spotted Leafhopper—transmits aster yellows.
Onion Thrips; Common Red Spider.

Potato Flea Beetle—small holes in foliage.
Cabbage Looper; Imported Cabbage Worm; Corn Earworm.

MINT

Four-lined Plant Bug—very common, small, dark, depressed spots in new leaves.

Mint Flea Beetle.
Cutworms; Grasshoppers; Millipedes; White Grubs (June beetle).

MISTLETOE

Cottony-cushion Scale; Greedy Scale; Purple Scale.

MOCKORANGE (*Philadelphus*)

Bean Aphid; Green Peach Aphid.

Leaf Miner—making curved, linear, or blotch mines, not described in other section; control not feasible.

MONKEYFLOWER (*Mimulus*)

Common Red Spider; Thrips; Yucca Mealybug.

Chalcedon (caterpillar).

MOONFLOWER

Argus Tortoise Beetle—holes in foliage.

Citrus Mealybug; Long-tailed Mealybug; Greenhouse Orthezia.
Sugarbeet Thrips; Leaf Nematode.

MORNING GLORY (*Convolvulus*)

Argus Tortoise Beetle; Golden Tortoise Beetle; Mottled Tortoise Beetle—rather frequent on foliage; **Spotted Cucumber Beetle; Sweetpotato Flea Beetle; Sweetpotato Weevil.**
Morning Glory Leaf Miner—serpentine tunnels in leaves.
Morning Glory Leaf Cutter.
Yellow Woolly Bear.

Myrtle Aphid; Garden Flea Hopper.
Greenhouse Whitefly; Inconspicuous Whitefly.
Soft Scale; Lesser Snow Scale.

MOUNTAIN-ASH (*Sorbus*)

Mountain-ash Sawfly—may eat everything but large veins; **Pear Slug.**
Japanese Beetle—feeds voraciously on foliage.
Roundheaded Apple Tree Borer—common and serious; **Flatheaded Apple Tree Borer; Shot-hole Borer; Sinuate Pear Borer; Pear Borer; Pacific Flatheaded Borer; Lilac Borer.**
Strawberry Rootworm; Rusty Tussock Moth.

Pear Leaf Blister Mite.
Woolly Apple Aphid; Rosy Apple Aphid—rather common, trailing white filaments on bark and leaves.
Scurfy Scale; San Jose Scale; Oystershell Scale; Cottony Maple Scale; Black Scale.

MOUNTAIN EBONY (*Bauhinia*)

Lesser Snow Scale.

MOUNTAIN LAUREL (*Kalmia*)

Rhododendron Lacebug—often takes color out of leaves in stippled fashion, so they appear grayish.
Mulberry Whitefly—dark with white fringe; may be common on backs of leaves.

Strawberry Flea Beetle—small holes in leaves.
Azalea Stem Borer; Rhododendron Borer.

MOUNTAIN MAHOGANY (*Cercocarpus*)

Pacific Flatheaded Borer, and other borers.

MUEHLENBECKIA

Florida Wax Scale.

MULBERRY (*Morus*)

Mulberry Whitefly—dark nymphs with white fringe.
Comstock Mealybug; Lightning Leafhopper—white masses on trunk.
Common Red Spider; Root-knot Nematode.
California Red Scale; Cottony Maple Scale; Florida Wax Scale; Greedy Scale; Olive Parlatoria; Peach Scale; San Jose Scale; Soft Scale.

Painted Hickory Borer—may tunnel in trunk.

MUSTARD
(See also Cabbage)

Turnip Aphid.
Green Stinkbug; Harlequin Bug; Citrophilus Mealybug.

Cabbage Maggot; Cabbage Curculio.
Western Black Flea Beetle; Western Striped Flea Beetle.
Black Blister Beetle; Vegetable Weevil.
Cabbage Looper; Diamondback Moth; Imported Cabbage Worm.

MYRTLE (*Myrtus*)

Black Scale; Barnacle Scale; Greedy Scale; Green Shield Scale; Oystershell Scale; Rose Scale; Soft Scale.
Lily Aphid; Myrtle Aphid; Citrus Mealybug.

NARCISSUS (Daffodil)

Narcissus Bulb Fly; Lesser Bulb Fly—large white maggots in rotting bulbs; **Bulb Mite**—in rotting bulbs.
Tulip Bulb Aphid—woolly white on bulbs; **Gladiolus Thrips.**
Stem and Bulb Nematode—"Eelworm Disease"; important.

Convict Caterpillar—black with cream bands; **Millipedes.**

NASTURTIUM (*Tropaeolum*)

Bean Aphid—black lice; almost inevitable; **Green Peach Aphid**—less likely; **Lily Aphid.**

Common Red Spider; Greenhouse Thrips.

Serpentine Leaf Miner; Celery Leaf Tier.

Cabbage Looper; Imported Cabbage Worm; Corn Earworm.

Flea Beetles.

NECTARINE

(See also Peach)

Oystershell Scale; San Jose Scale; Peach Scale.

Plum Leafhopper; Western Flower Thrips; Green Stinkbug.

Fig Beetle; Green June Beetle; Plum Curculio.

Peachtree Borer; Peach Twig Borer; Shot-hole Borer.

NELUMBO (Lotus)

Waterlily Aphid; Melon Aphid.

NEMESIA

Melon Aphid.

NERINE

Banded Greenhouse Thrips.

NEW JERSEY TEA (*Ceanothus americanus*)

Oystershell Scale.

NINEBARK

Iris Whitefly; Glacial Whitefly.

Dogwood Borer.

OAK (*Quercus*)

Fall and Spring Cankerworms—in some seasons nearly defoliate all oaks in a community.

California Oak Worm—defoliates live and other oaks at long intervals.

California Tent Caterpillar; Eastern Tent Caterpillar; Forest Tent Caterpillar; Fall Webworm; Oak Looper.

Orange-striped Oak Worm; Green-striped Maple Worm; Spiny Oak Worm.

Puss Caterpillar; Saddleback Caterpillar; Saddled Prominent; Variable Oak-leaf Cutter; Walnut Caterpillar; Yellow-necked Caterpillar.

Fruit Tree Leaf Roller; Oak Leaf Roller; Oblique-banded Leaf Roller; Orange Tortrix (caterpillar).

Gypsy Moth—very fond of oak; **Brown-tail moth; Buck Moth; Cecropia Moth; Imperial Moth; Io Moth; Luna Moth; Polyphemus Moth; Satin Moth; Spotted Tussock Moth; Western Tussock Moth; Oriental Moth.**

Two-lined Chestnut Borer; Leopard Moth; Oak Twig Girdler; Broad-necked Root Borer; California Prionus; Carpenter Worm; Pecan Carpenter Worm; Flatheaded Apple Tree Borer; Live Oak Root Borer; Oak Sapling Borer; Pacific Flatheaded Borer; Pigeon Tremex; Tiger Hickory Borer.

White Blotch Leaf Miner; Locust Leaf Beetle; Fuller Rose Beetle; June Beetle; Northern Brenthian; Carrot Beetle.

Walkingstick.

Oak Galls—many, various; usually not injurious to any extent.

Periodical Cicada—every 17 years, in some locality, oaks are covered with browned branches, hanging down after cicada egg-laying.

Oak Lacebug—common; leaves may be completely whitened.

Oak Gall Scale or **Kermes; Pit-making Oak Scale; California Red Scale; Cottony-cushion Scale; Cottony Maple Scale; Greedy Scale; Obscure Scale; Lecanium Scale; Oystershell Scale; Putnam Scale; Purple Scale.**

Southern Red Mite; Avocado Red Mite.

Citrus Whitefly; Crown Whitefly; Glacial Whitefly; Inconspicuous Whitefly.

Okra

Japanese Beetle; Flea Beetles; Striped Cucumber Beetle; Grape Colaspis.

Abutilon Moth or **Okra Caterpillar; Corn Earworm; Cutworms.**

Green Stinkbug; Southern Green Stinkbug; Harlequin Bug; Pumpkin Bug.

Melon Aphid; Common Red Spider; Whiteflies; Root-knot Nematode.

Oleander

Oleander Scale—yellow; **Black Scale; Florida Red Scale; Hemispherical Scale; Florida Wax Scale; Lesser Snow Scale; Olive Parlatoria; Peach Scale; Soft Scale.**

Oleander Aphid—yellow and black; **Bean Aphid**—black; **Green Peach Aphid.**

Citrus Mealybug; Long-tailed Mealybug.

Subterranean Termite.

Olive

Black Scale; California Red Scale; Greedy Scale; Oleander Scale; Olive Parlatoria; Pineapple Scale; Purple Scale.
Bean Thrips; Citrus Thrips.

Branch and Twig Borer; Olive Bark Beetle.
Omnivorous Looper.

Onion

Onion Thrips—leaves silvery, streaked, plant distorted.
Bulb Mite; Stem and Bulb Nematode—dark circles in bulb; **Common Red Spider.**

Onion Maggot—may kill seedlings, older plants with maggoty bulbs; **Lesser Bulb Fly; Seed-corn Maggot.**
Imbricated Snout Beetle; Vegetable Weevil; Blister Beetles.
Fruit Tree Leaf Roller; Fall Armyworm; Wireworms; Cutworms.

Orange

(See also Citrus)

Purple Scale; Black Scale; California Red Scale; Florida Red Scale; Cottony-cushion Scale; Greedy Scale; Hemispherical Scale; Oleander Scale; Putnam Scale; San Jose Scale; Soft Scale.
Citrus Rust Mite; Citrus Red Mite; Citrus Whitefly.
Citrus Thrips; Greenhouse Thrips; Bean Thrips.
Long-tailed Mealybug; Grape Mealybug; Ground Mealybug.
Green Stinkbug; Leaf-footed Bug; Western Leaf-footed Bug.
Cowpea Aphid; Green Peach Aphid; Melon Aphid; Spirea Aphid.

Omnivorous Looper; Orange Tortrix; Tobacco Flea Beetle.
Orange Sawyer; California Prionus (borer); **Subterranean Termite.**

Orchid

Orchid Weevil—small, black, common; **Cattleya Weevil; Dendrobium Weevil.**
Dendrobium Borer; Bulb Borer.
Orchid Fly—small black fly; maggots turn buds brown; **Cattleya Midge**—in tips of roots.
Slugs; Snails.

Orchid Plant Bug; Citrus Mealybug; Common Red Spider.
Greenhouse Thrips, and other species.

Lantana Aphid; Lily Aphid.

Leaf Nematode—brown blotches in leaves.

Black Scale; Boisduval's Scale; Chaff Scale; Cyanophyllum Scale; Florida Red Scale; Hemispherical Scale; Latania Scale; Oleander Scale; Oystershell Scale; Purple Scale; Tea Scale; Tessellated Scale.

Osage Orange (*Maclura pomifera*)

Cottony Maple Scale; European Fruit Lecanium; Putnam Scale; San Jose Scale.

Comstock Mealybug; Citrus Whitefly.

Pachysandra (Japanese Spurge)

Euonymus Scale—common, conspicuous from the white male scales; **Oystershell Scale; San Jose Scale.**

Common Red Spider—may be serious if plants are too crowded.

Palmetto (Sabal, Cabbage Palm)

Palm Leaf Miner—major pest in Florida—skeletonizes leaves.

Citrus Whitefly; Glover Scale.

Palms

Black Scale; Black Thread Scale; Boisduval's Scale; California Red Scale; Chaff Scale; Cottony-cushion Scale; Dictyosperum Scale; Fern Scale; Florida Red Scale; Glover Scale; Greedy Scale; Oleander Scale; Olive Parlatoria; Pineapple Scale; Soft Scale; Tea Scale; Tessellated Scale.

Citrus Mealybug; Long-tailed Mealybug; Palm Mealybug.

Greenhouse Thrips; Dracaena Thrips; Banded Greenhouse Thrips.

Lantana Aphid; Green Peach Aphid.

Black Vine Weevil; Fuller Rose Beetle.

Palm Leaf Miner—leaf skeletonizer; major pest in Florida.

You don't have to identify the scale to keep indoor palms washed or syringed off. Oil sprays, with 1½ per cent actual oil, are usually used for outdoor palms. Thiocyanate sprays are often used for mealybugs. Control ants.

Palo Verde

Termites; Borers—undescribed in this manual.

Pandanus

Long-tailed Mealybug; Yellow Scale—var. of **California Red Scale.**

Pansy (*Viola*)

(See also Violet)

Foxglove Aphid; Root-knot Nematode.

Violet Sawfly; Celery Leaf Tier; Cutworms; Slugs; Termites.

Papaya

Root-knot Nematode.

Paradise Vine

Lesser Snow Scale.

Parkinsonia

Lesser Snow Scale.

Parsley

Black Swallowtail (caterpillar); **Cabbage Looper; Celery Leaf Tier.**
Carrot Weevil—grubs burrow in stalks; **Carrot Rust Fly.**

Six-spotted Leafhopper—transmits aster yellows.
Root-knot Nematode; Stem and Bulb Nematode.

Parsnip

Parsnip Webworm; Parsnip Leaf Miner.
Carrot Rust Fly—tunnels in roots; **Millipedes.**
Carrot Beetle; Carrot Weevil; Asiatic Garden Beetle; Pale-striped Flea Beetle.
Yellow Woolly Bear and **Black Swallowtail**—occasional caterpillars.

Bean Aphid; Honeysuckle Aphid; Stem and Bulb Nematode.

Passion Flower or Vine (*Passiflora*)

Citrus Mealybug; Grape Mealybug.
California Red Scale; Greedy Scale; Purple Scale.

Omnivorous Looper; Celery Leaf Tier.

Pea

Pea Aphid—large, green, important, causing much loss; **Bean Aphid; Potato Aphid.**
Common Red Spider—serious in dry weather; vines yellow, dry.
Onion Thrips; Western Flower Thrips; Greenhouse Whitefly.
Garden Flea Hopper; Green Stinkbug; Say Stinkbug; Root-knot Nematode.

Seed-corn Maggot—may injure seedlings.

Pea Weevil—worms in seeds; **Broadbean Weevil.**

Pea Moth—small caterpillars drill in pods.

Beet Webworm; Celery Leaf Tier.

Green Clover Worm; Alfalfa Caterpillar; Cabbage Looper; Yellow Woolly Bear; Corn Earworm; Lesser Cornstalk Borer.

Bean Leaf Beetle; Blister Beetles; Imbricated Snout Beetle; Pale-striped Flea Beetle; Spotted Cucumber Beetle; Striped and **Western Striped Cucumber Beetles.**

Field Cricket; Millipedes; Garden Centipede.

Peach

Peachtree Borer—very common; serious; gum at base of trunk; dieback, yellowing of branches; **Lesser Peach Borer; Western Peach Borer; Peach Twig Borer; Shot-hole Borer; Branch and Twig Borer; California Prionus; Pacific Flatheaded Borer.**

Oriental Fruit Moth—blackens tips of shoots; **Codling Moth; Plum Curculio; Cherry Fruit Sawfly**—worms in fruit; **Mexican Fruitfly** (Texas).

Japanese Beetle—prevalent on fruit and foliage; **Asiatic Garden Beetle; Bumble Flower Beetle; Cherry Leaf Beetle; Fig Beetle; Green June Beetle; Rose Chafer; Rose Leaf Beetle; Strawberry Rootworm; Peach Bark Beetle; Plum Gouger.**

Black-horned Tree Cricket; Snowy Tree Cricket.

California Casebearer; Forest Tent Caterpillar; Yellow-necked Caterpillar; Cankerworms; Fall Webworm; Oblique-banded Leaf Roller; Corn Earworm.

San Jose Scale—commonly injurious, small, round, grayish, nippled; **Scurfy Scale; Cottony-cushion Scale; Cottony Maple Scale; European Fruit Lecanium; Grape Scale; Howard Scale; Italian Pear Scale; Peach Scale; Florida Wax Scale; Soft Scale; Terrapin Scale; Walnut Scale; White Peach Scale.**

Green Peach Aphid; Black Peach Aphid; Hop Aphid; Mealy Plum Aphid; Black Cherry Aphid.

Pear Thrips; Western Flower Thrips.

Common Red Spider; Clover Mite; other mites.

Plum Leafhopper; Buffalo Treehopper.

Citrophilus Mealybug; Ground Mealybug; Tarnished Plant Bug; Boxelder Bug; Green Stinkbug; Root-knot Nematode.

Despite the possible insect pests listed above, a peach spray schedule is designed primarily to control brown rot, leaf curl, and other diseases. Arsenical sprays must be used with great caution on peaches and plums.

Lead arsenate as made up for shade-tree pests will give severe burning of foliage, and even the sprays recommended for apples are unsafe on peaches. (Figure 105.)

Peach Spray Schedule

1. *Dormant Spray*

Apply *before* buds start to swell, to control leaf curl and San Jose scale.

1½ cups liquid lime-sulfur
1 gal. water

2. *Husk Spray*

Apply when husks start to split from the young fruits, to control scab, brown rot, and curculio.

Wettable sulfur as recommended by manufacturer.
2 scant tbsps. lead arsenate
2 tbsps. flake zinc sulfate or 4 teaspoons powdered zinc sulfate
4 tbsps. hydrated lime
1 gal. water

Zinc sulfate can be omitted and 5 tablespoons of lime used instead of 4, but there will be more danger of foliage injury.

Add 1 teaspoon nicotine sulfate if aphids are numerous.

3. *Two Weeks after 2.*

To control brown rot, scab, and curculio.
Same as 2.

4. *Two or Three Weeks after 3.*

To control brown rot and scab.
Wettable sulfur as recommended by manufacturer.

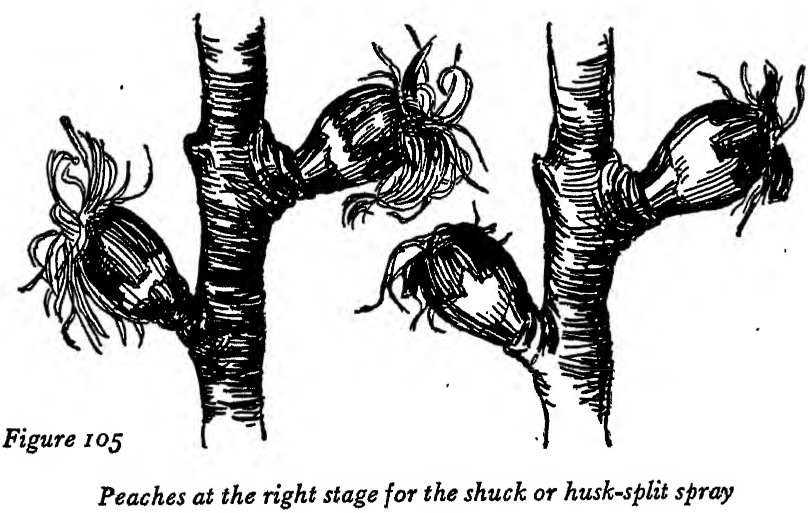


Figure 105

Peaches at the right stage for the shuck or husk-split spray

A 70–10–20 sulfur-lead arsenate-lime dust can be substituted for sprays in number 2 and 3, and an 80–20 sulfur-lime dust for number 4.

To control Japanese beetles use a special rotenone spray during the summer.

The peach-spray schedule may be modified by the use of DDT, both as a foliage spray and for the peachtree borer (see the Bug section), so consult your experiment station for latest recommendations for your state.

Peanut

Velvetbean Caterpillar—serious in Gulf region, chewing foliage; **Yellow Woolly Bear; Corn Earworm; Fall Armyworm.**

Locust Leaf Miner; Pale-striped Flea Beetle; Corn Billbugs (beetles).

Lesser Cornstalk Borer.

Potato Leafhopper.

Pearl Bush (*Exochorda*)

Gall Mite.

Pear

Pear Leaf Blister Mite—blisters in leaves, which may drop; **Clover Mite; European Red Mite.**

Pear Psylla—leaves and fruit black; defoliation.

Pear Thrips—blossoms look as if burned.

Apple Redbud; Pear Plant Bug; Tarnished Plant Bug (false); **Citrophilus Mealybug; Grape Mealybug; Citrus Whitefly.**

Woolly Pear Aphid; Woolly Apple Aphid; Rosy Apple Aphid; Apple Grain Aphid; Clover Aphid; Cowpea Aphid; Buffalo Treehopper.

San Jose Scale; Scurfy Scale; Oystershell Scale; Black Scale; Calico Scale; Barnacle Scale; Cottony-cushion Scale; Cottony Maple Scale; European Fruit Lecanium; Forbes Scale; Greedy Scale; Howard Scale; Italian Pear Scale; Florida Wax Scale; Lecanium Scale; Olive Parlatoria; Peach Scale; Rose Scale; Soft Scale; Walnut Scale; White Peach Scale.

Pear Slug (sawfly)—leaves skeltonized; rather common; **Leaf Crumpler; Unspotted Tentiform Leaf Miner; Fruit Tree Leaf Roller; Oblique-banded Leaf Roller.**

Codling Moth; Plum Curculio; Quince Curculio; Apple Curculio—wormy fruit.

Pear Midge—maggots in young fruit, which drops; **Cherry Fruitfly; Mexican Fruitfly.**

Brown-tail Moth; Oriental Fruit Moth; Eye-spotted Budmoth; Western Tussock Moth; White-lined Sphinx; White-marked Tussock Moth.

Forest Tent Caterpillar; Red-humped Caterpillar; Yellow-necked Caterpillar; Corn Earworm.

California Casebearer; Cigar Casebearer.

Fig Beetle; Green June Beetle; Rose Chafer; Rose Leaf Beetle; New York Weevil; Pale-striped Flea Beetle.

Pear Borer; Sinuate Pear Borer; Roundheaded Apple Tree Borer; Flatheaded Apple Tree Borer; Pacific Flatheaded Borer; Brown Wood Borer; Carpenter Worm; Leopard Moth; Shot-hole Borer; Branch and Twig Borer; Pigeon Tremex.

Snowy Tree Cricket; Subterranean Termites.

In general the apple-spray schedule is used for pears, but the dormant oil spray is particularly important if blister mite and pear psylla are problems. It also helps to control leaf rollers.

Pecan

Pecan Weevil—worms in nuts; a serious pest.

Pecan Leaf Casebearer; Pecan Nut Casebearer; Pecan Cigar Casebearer.

Omnivorous Looper; Walnut Caterpillar; Fall Webworm.

Pecan Budmoth.

Pecan Borer; Pecan Carpenter Worm; Dogwood Borer; Flatheaded Apple Tree Borer; Twig Pruner.

Camphor Scale; Cottony-cushion Scale; European Fruit Lecanium; Greedy Scale; Obscure Scale; Purple Scale; San Jose Scale.

Hickory Aphid; Hickory Leaf Aphid; Green Stinkbug.

Avocado Red Mite; Root-knot Nematode.

Penstemon

Foxglove Aphid; Lily Aphid.

Fuller Rose Beetle; Chalcedon (caterpillar).

Pentas

Orange Tortrix (caterpillar).

Peony

Rose Chafer—long-legged tan beetle loves flowers; **Japanese Beetle**—recorded on peony, but all except very late varieties are through blooming before adults emerge.

Ants—usually present on sticky secretion of buds, but are not injurious, unless possibly by spreading disease spores.

Greenhouse Thrips, and other species—petals turn brown.

Four-lined Plant Bug—tan, depressed circular spots in leaves.
Oystershell Scale—often present where old stems are not cut down each fall.
Root-knot Nematode—swellings on roots, causing stunted plants.

Pepper

Potato Aphid; Green Peach Aphid; Melon Aphid.
Greenhouse Whitefly—quite common on plants set out from greenhouses.
Cyclamen Mite; Broad Mite; Ground Mealybug; Citrophilus Mealybug.
Beet Leafhopper; Garden Flea Hopper; Tomato Psyllid.
Pumpkin Bug; Leaf-footed Plant Bug; Root-knot Nematode.
Common Red Spider; Greenhouse Orthezia; Cottony-cushion Scale.

Potato Flea Beetle—minute holes in leaves after setting out.
Pepper Maggot—rather common cause of fruit decay; **Pepper Weevil**—grubs in fruit.
Colorado Potato Beetle; Asiatic Garden Beetle; Blister Beetle; Rose Chafer.
Corn Earworm; Serpentine Leaf Miner; Tobacco Hornworm.

Pepper Grass

Western Black Flea Beetle.

Pepper Tree (*Schinus molle*)

Black Scale—very common; **Barnacle Scale; Fern Scale; Greedy Scale; Hemispherical Scale; Lesser Snow Scale; Oleander Scale.**
Citrophilus Mealybug; Citrus Thrips.

Omnivorous Looper.

Periwinkle (*Vinca*)

Melon Aphid; Green Peach Aphid; Potato Aphid and other species.
Six-spotted Leafhopper; Olive Parlatoria (scale).

Fuller Rose Beetle.

Persimmon (*Diospyros*)

Persimmon Root Borer; Flatheaded Apple Tree Borer.
Fuller Rose Beetle.
Variable Oak-leaf Caterpillar; Red-humped Caterpillar; Hickory Horned Devil.

Black Scale; Barnacle Scale; Camphor Scale; European Fruit Lecanium; Green Shield Scale; Putnam Scale; San Jose Scale; White Peach Scale.

Citrus Whitefly; Citrus Mealybug; Greenhouse Thrips.

Petunia

Potato Flea Beetle—tiny shot holes in leaves; **Colorado Potato Beetle; Asiatic Garden Beetle.**

Yellow Woolly Bear (caterpillar); **White-lined Sphinx** (moth).

Greenhouse Orthezia—scale-like with white plates of wax.

Six-spotted Leafhopper; Ground Mealybug.

Tomato Russet Mite—transmits mosaic.

Phacelia (California Bluebell)

Leaf Curl Plum Aphid.

Phlox

Common Red Spider—leaves yellow, webby; very common.

Phlox Plant Bug—oval, reddish-orange bug causes white spots on leaves, deformed buds.

Six-spotted Leafhopper—transmits aster yellows.

Stem and Bulb Nematode—deforms plants, twists stem, leaves.

Soft Scale; Black Scale.

Potato Flea Beetle; Black Blister Beetle; Corn Earworm; Stalk Borer.

Physostegia

Foxglove Aphid.

Pine

Pine Sawflies—very common and injurious; denude branches, kill young trees and small ornamentals; **European Pine Sawfly; Introduced Pine Sawfly; Loblolly Pine Sawfly; Red-headed Pine Sawfly; Spruce Sawfly; White-pine Sawfly.**

Pine Webworms—web needles together, feed inside; **Hemlock Looper; Pine Butterfly** (caterpillar).

White-pine Weevil—leader dies back; is conspicuously brown or tan; **Pales Weevil; Deodar Weevil; Monterey Pine Weevil; Cypress Tip Moth.**

European Pine Shoot Moth—very common on ornamentals, tips yellow, crooked; **Gypsy Moth; Imperial Moth; Nantucket Pine Moth; Pandora Moth; Pine Tube Moth; Pitch Twig Moth; Sequoia Pitch Moth; Zimmerman Pine Moth; White-pine Tip Moth.**

Spruce Budworm; Pine Needle Miner; Lodgepole Pine Needle Miner; Bagworm; Yellow-bellied Sapsucker (bird).

Bark Beetles are common and important—**Pine Bark Beetle** or engraver; **Black Turpentine Beetle; Colorado Pine Beetle; Mountain Pine Beetle; Northeastern Sawyer; Red Turpentine Beetle; Southern Pine Beetle; Southwestern Pine Beetle; Western Pine Beetle.**

White-pine Cone Beetle; Pine Colaspis; Monterey Pine Midge.

Cedar Tree Borer; Fir Flatheaded Borer; Broad-necked Root Borer; Brown Wood Borer.

Pine Needle Scale—white, pear-shaped on needles, which often turn yellow; **Barnacle Scale; Cottony-cushion Scale; Hemlock Scale; Florida Wax Scale; Scotch Pine Lecanium**—large, brown.

Pine Bark Aphid—common though not usually very injurious; white fluffs on trunk and underside of limbs; **Pine Leaf Aphid; Monterey Pine Aphid.**

Pine Spittle Bug—white frothy mass; may be quite injurious.

Spruce Mite—needles look grayish or webby.

Cypress Mealybug; Golden Mealybug; Comstock Mealybug.

A dormant oil spray before growth starts in spring, lead arsenate applied in time to control sawfly larvae and other chewing insects, plus general sanitation, will take care of most pine problems. In using oil on evergreens the right dilution and a day when the temperature is above 45° F. are both important.

Pineapple

Pineapple Scale; Pineapple Mealybug.

Root-knot Nematode.

Pink (*Dianthus*)

(See also Carnation)

Greenhouse Thrips; Common Red Spider.

Pittosporum

Cottony-cushion Scale—white fluted sacs, and usually much sooty mold growing in honeydew; **Camellia Scale; Black Scale; Greedy Scale; Florida Wax Scale; Lesser Snow Scale; Soft Scale.**

Plum

Black Peach Aphid; Green Peach Aphid; Hop Aphid; Leaf Curl Plum Aphid; Mealy Plum Aphid; Thistle Aphid; Waterlily Aphid—any one or several of these aphids may be present on new shoots.

European Fruit Lecanium—very convex brown scale; **San Jose Scale**—gray-white, small, round; **Black Scale; Cottony Maple Scale; Forbes Scale; Howard Scale; Italian Pear Scale; Florida Wax Scale; Obscure Scale; Olive Parlatoria; Peach Scale; Putnam Scale; Soft Scale; Lecanium Scale; Terrapin Scale; Walnut Scale; White Peach Scale.**

European Red Mite; Pacific Mite; Clover Mite; Pear Thrips; Western Flower Thrips.

Grape Leafhopper; Plum Leafhopper; Boxelder Bug; Harlequin Bug.

Citrophilus Mealybug; Long-tailed Mealybug; Ground Mealybug.

Plum Curculio—crescent marks on wormy fruit, which rots; **Codling Moth; Cherry Fruit Sawfly; Black Cherry Fruitfly; Apple Maggot; Mexican Fruitfly.**

Japanese Beetle; Green June Beetle; Plum Gouger; Rose Leaf Beetle; Fuller Rose Beetle; Grape Flea Beetle.

Pear Slug (sawfly) ; **Plum Web-spinning Sawfly.**

Peachtree Borer; Lesser Peach Borer; Peach Twig Borer; Shot-hole Borer; Western Peach Borer; Flatheaded Apple Tree Borer; California Prionus; Pacific Flatheaded Borer.

Cankerworms; California Tent Caterpillar; Forest Tent Caterpillar; Yellow-necked Caterpillar; Red-humped Caterpillar.

Fruit Tree Leaf Roller; Oblique-banded Leaf Roller; Red-banded Leaf Roller; Apple Leaf Skeletonizer; Leaf Crumpler.

Cigar Casebearer; California Casebearer.

Snowy Tree Cricket.

Artichoke Plume Moth; Brown-tail Moth; Leopard Moth; Western Tussock Moth; White-lined Sphinx; White-marked Tussock Moth.

For plums, as for peaches, the schedule is primarily for the control of fungus brown rot.

A Plum Spray Schedule

1. *Dormant Spray*

Apply just before the buds open, to control scales, brown rot, black knot.

1½ cups lime-sulfur
1 gal. water

2. *Petal-fall Spray*

Apply immediately after petals fall to control curculio and brown rot.

Wettable sulfur according to manufacturer's directions
2 scant tbsps. lead arsenate
2 tbsps. flake zinc sulfate
4 tbsps. hydrated lime
1 gal. water
1 tsp. nicotine sulfate can be added for aphids.

3. *Green Fruit Spray*
   Apply when fruit is size of small peas, for curculio, brown rot.
   Same as 2.
4. Later sprays are of wettable sulfur only, to control brown rot.

Use great caution in spraying ornamental plums with lead arsenate to control Japanese beetles; often the spray makes the leaves fall. A rotenone dust seems much safer, and fairly effective if repeated weekly.

Plumbago

Fuller Rose Beetle.

Citrus Mealybug.

Poinsettia

Citrus Mealybug; Long-tailed Mealybug.
Oleander Scale—pale yellow; **Soft Scale**—brown; **Cottony-cushion Scale.**
Poinsettia Root Aphid—woolly white, at roots.

Pomegranate

Western Leaf-footed Plant Bug.
Black Scale; Citricola Scale; Cottony-cushion Scale; Greedy Scale; Florida Wax Scale; Mining Scale; Olive Parlatoria.
Citrus Whitefly; Greenhouse Thrips; Citrus Thrips.

Poplar

Poplar Borer—large beetle, making galleries in wood, swollen scars outside; **Poplar and Willow Borer**—small beetle; may girdle trees; **Broad-necked Root Borer; Bronzed Birch Borer; California Prionus; Carpenter Worm; Flatheaded Apple Tree Borer; Pacific Flatheaded Borer; Pigeon Tremex.**
Cottonwood Leaf Beetle; Imported Willow Leaf Beetle; Goldsmith Beetle; June Beetle; Alder Flea Beetle; Willow Flea Weevil.
Poplar Sawfly; Willow Sawfly; Elm Sawfly.
Poplar Tent Maker; Eastern Tent Caterpillar; Forest Tent Caterpillar; Mourning Cloak; Red-humped Caterpillar; Saddled Prominent; Fall Webworm; Fruit Tree Leaf Roller; Oblique-banded Leaf Roller; Spiny Elm Caterpillar.
Cecropia Moth; Hornet Moth; Io Moth; Leopard Moth; Oriental Moth; Polyphemus Moth; Rusty Tussock Moth; Satin Moth; White-marked Tussock Moth.
Giant Hornet.

Poplar Leaf Aphid; Poplar Vagabond Aphid; Poplar Stem Gall Aphid; Beet Root Aphid.

Oystershell Scale; San Jose Scale; Willow Scale; Cottony Maple Scale; Black Scale; European Fruit Lecanium; Lecanium Scale; Soft Scale.

Comstock Mealybug; Poplar Leafhopper.

Poppy (*Papaver*)

Bean Aphid—black; frequent; **Green Peach Aphid; Melon Aphid.**

Four-lined Plant Bug; Tarnished Plant Bug.

Six-spotted Leafhopper; Grape Mealybug.

Rose Chafer.

Portulaca

White-lined Sphinx (moth).

Potato

Colorado Potato Beetle—very convex striped beetle with red, hump-backed larva, both devouring foliage; **Three-lined Potato Beetle; Western Potato Beetle.**

Potato Flea Beetle—small, black, tiny holes in leaves; **Tobacco Flea Beetle; Black Blister Beetle; Carrot Beetle; Fuller Rose Beetle; June Beetle; Spotted Blister Beetle; Spotted Cucumber Beetle; Strawberry Leaf Beetle; Tortoise Beetles; Imbricated Snout Beetle.**

Cabbage Looper; Yellow Woolly Bear; Tobacco Hornworm; Beet Web-worm.

Potato Tuber Worm; Fall Armyworm.

Vegetable Weevil; Seed-corn Maggot; Serpentine Leaf Miner.

Jerusalem Cricket; Wireworms; Millipedes; Grasshoppers.

Potato Stalk Borer; Stalk Borer; European Corn Borer.

Potato Leafhopper—may cause serious burning and rolling of leaves, stunted plants; **Garden Flea Hopper.**

Potato Aphid; Green Peach Aphid; Myrtle Aphid.

Potato Psyllid; Tomato Russet Mite.

Citrophilus Mealybug; Grape Mealybug; Citrus Whitefly.

Tarnished Plant Bug; Leaf-footed Plant Bug; Eggplant Lacebug; Harlequin Bug; Say Stinkbug; Southern Green Stinkbug; Pumpkin Bug.

Root-knot Nematode.

Potentilla

Strawberry Root Weevil.

Prickly Ash (*Xanthoxylum americanum*)

European Fruit Lecanium; Howard Scale; Florida Wax Scale.

Primrose

Common Red Spider—plants in midsummer in garden always turn yellow with mealy webs.

Greenhouse Whitefly; Long-tailed Mealybug; Yucca Mealybug.

Green Peach Aphid; Foxglove Aphid; Cowpea Aphid; Corn Root Aphid.

Stem and Bulb Nematode.

Black Vine Weevil—grubs work on roots.

Slugs—large holes in foliage.

Potato Flea Beetle; Steel-blue Flea Beetle; Strawberry Flea Beetle—minute holes in foliage.

Fuller Rose Beetle—leaves chewed in from margins.

Privet (*Ligustrum*)

Citrus Whitefly—very common in southern gardens.

Citrophilus Mealybug; Ground Mealybug.

Olive Parlatoria; San Jose Scale; Black Scale; California Red Scale; Camphor Scale; Japanese Scale; Mining Scale; White Peach Scale.

Privet Thrips—leaves grayish; **Privet Mite.**

Lilac Leaf Miner; Privet Leaf Miner.

Sweetpotato Leaf Beetle.

Prune

(See Plum)

Pumpkin

(See also Squash)

Squash Borer; Melon Worm.

Squash Beetle; Striped and **Western Striped Cucumber Beetles; Spinach Carrion Beetle; Blister Beetles.**

Potato Flea Beetle.

Yellow Woolly Bear (caterpillar); **Corn Earworm.**

Squash Bug; Citrus Mealybug; Garden Flea Hopper.

Melon Aphid; Potato Aphid, and other species.

Root-knot Nematode.

Pyracantha

Hawthorn Lacebug—leaves lose color in stippled effect, brown dots on underside—whole shrubs grayish.

Greedy Scale; Olive Parlatoria.

Green Apple Aphid.

Quince

Japanese Beetle; Grape Flea Beetle; Apple Flea Weevil.

Oriental Fruit Moth—important; **Rusty Tussock Moth, White-marked Tussock Moth; Pear Slug** (sawfly).

Quince Curculio; Apple Curculio; Codling Moth; Mexican Fruitfly.

Fruit Tree Leaf Roller; Apple Leaf Skeletonizer; Leaf Crumpler; Unspotted Tentiform Leaf Miner; Forest Tent Caterpillar; Yellow-necked Caterpillar.

San Jose Scale; Oystershell Scale; Scurfy Scale; California Red Scale; Barnacle Scale; Cottony-cushion Scale; Cottony Maple Scale; European Fruit Lecanium; Forbes Scale; Greedy Scale; Putnam Scale.

Buffalo Treehopper.

Clover Aphid; Green Apple Aphid; Apple Grain Aphid; Woolly Apple Aphid. A quince-spray schedule can be adapted from that given for apples. To control Japanese beetles in the summer use one of the special rotenone sprays.

Radish

(See also Cabbage)

Cabbage Maggot—seedlings wilt; **Seed-corn Maggot.**

Pale-striped Flea Beetle; Potato Flea Beetle; Sinuate-striped Flea Beetle; Western Black Flea Beetle; Western Striped Flea Beetle.

Black Blister Beetle; Striped Blister Beetle; Red Turnip Beetle.

Vegetable Weevil; Cabbage Curculio.

Cabbage Looper; Yellow Woolly Bear (caterpillar); **Imported Cabbage Worm; Diamondback Moth; Serpentine Leaf Miner.**

Garden Centipede; Wireworms; Garden Springtail.

Cabbage Aphid; Turnip Aphid; Green Peach Aphid.

Raspberry

Raspberry Cane Borer and **Raspberry Cane Maggot**—tips die back; **Red-necked Cane Borer; Rose Stem Girdler; Flatheaded Apple Tree Borer; Raspberry Root Borer.**

Raspberry Fruitworm—beetles injure buds, larvae tunnel fruit.

Japanese Beetle—very fond of raspberry foliage and berries; **Alfalfa Snout Beetle; Argus Tortoise Beetle; Fuller Rose Beetle; Green June Beetle; Imbricated Snout Beetle; Rose Chafer; Rose Leaf Beetle; Strawberry Rootworm; Black Vine Weevil; Rough Strawberry Weevil; Strawberry Root Weevil; Strawberry Crown Moth.**

Raspberry Sawfly; Green Clover Worm; Strawberry Leaf Roller; Fruit Tree Leaf Roller; Orange Tortrix; Yellow Woolly Bear.

Black-horned Tree Cricket.

Raspberry Aphid—may transmit mosaic; **Grape Leafhopper; Clover Mite; Glacial Whitefly; Common Red Spider.**

Strawberry Spittle Bug; Negro Bug—bad taste to berries.

Rose Scale; Oystershell Scale; Scurfy Scale; Latania Scale; Soft Scale.

The easiest system of control is to cut out infested canes and to rely mostly on rotenone, with the help of sulfur dust for mites and bait for weevils.

Redbud or Judas Tree (*Cercis*)

Oleander Scale; Greedy Scale; Terrapin Scale.

Greenhouse Whitefly; Two-marked Treehopper.

California Tent Caterpillar; Grape Leaf Folder.

Redberry (*Rhamnus*)

Iridescent Whitefly.

Redwood (*Sequoia*)

Cedar Tree Borer; Sequoia Pitch Moth.

Cypress Mealybug; Citrus Mealybug; Yucca Mealybug.

Oleander Scale; Greedy Scale.

Retinospora

Arborvitae Aphid.

Black Vine Weevil.

Rhododendron

Rhododendron Lacebug—almost always present on rhododendron in sun. Leaves yellowed or stippled white or gray on upper surface, lower covered with brown flecks.

Taxus Mealybug; Rhododendron Midge.

Rhododendron Aphid; Oleander Scale.

Greenhouse Thrips; Onion Thrips; Madrona Thrips; Whitefly.

Rhododendron Borer—common; holes in trunk; **Azalea Stem Borer; Broad-necked Root Borer.**

Black Vine Weevil; Ambrosia Beetle; Asiatic Garden Beetle.

Giant Hornet.

Rhubarb

Rhubarb Curculio; Alfalfa Snout Beetle; Potato Flea Beetle; Japanese Beetle—common.

Stalk Borer; European Corn Borer; Yellow Woolly Bear.

Potato Leafhopper; Black Scale; Citrus Mealybug.

ROSE

Japanese Beetle—lovely bronzy-green, iridescent, demolishes flowers, turns foliage to lace unless sprayed or dusted weekly; **Rose Chafer**—tan, long-legged beetle, devours flowers during its short season; **Spotted Cucumber Beetle** (Diabrotica)—feeds on flowers; more serious in warm climates.

Rose Sawfly, Curled Rose Sawfly and **Bristly Rose Slug**—slug-like larvae skeletonizing foliage, very destructive, particularly early in season.

Rose Midge—buds turn black, shoots twisted, blackened, flowers, if any, deformed, bloom often entirely prevented.

Rose Curculio—red-and-black snout beetle, eats buds; **Green Fruitworm**—also works on buds.

Asiatic Garden Beetle; Fuller Rose Beetle; Goldsmith Beetle; Grape Colaspis; June Beetle; Oriental Beetle; Rose Leaf Beetle; Strawberry Leaf Beetle; Strawberry Rootworm; Imported Long-horned Weevil.

Rose Stem Girdler—spiral swelling in bark; **Raspberry Cane Borer** and **Raspberry Cane Maggot**—tips die back; **Red-necked Cane Borer; Rose Root Gall; Mossy Rose Gall; Flatheaded Apple Tree Borer; Pacific Flatheaded Borer.**

Leaf Cutter Bee—perfect ovals and circles cut out of leaves.

Eastern Tent Caterpillar; Coast Tent Caterpillar; Forest Tent Caterpillar; Brown-tail Moth; Red-humped Caterpillar; Corn Earworm; Celery Leaf Tier; Oblique-banded Leaf Roller; Fall Webworm.

European Earwig; Walkingstick; Grasshoppers; Mice; Rabbits—injure in winter, especially if straw or leaves are used for protection.

Potato Aphid—pink or green on new shoots; **Green Peach Aphid; Melon Aphid; Rose Aphid; Small Green Aphid.**

Rose Leafhopper, Apple Leafhopper, White Apple Leafhopper, Potato Leafhopper—foliage sucked white in a flecked or stippled pattern; **Red-banded Leafhopper; Virginia Creeper Leafhopper.**

Onion Thrips, Greenhouse Thrips; Flower Thrips; Florida Flower Thrips; Western Flower Thrips—flowers balled with brown edges to petals or buds brown, not opening.

Common Red Spider—yellowing, webby foliage, more serious in sheltered locations; **Four-lined Plant Bug; Harlequin Bug.**

Rose Scale—white, circular, and sort of fuzzy; **Black Scale; Cottony-cushion Scale; California Red Scale; Camphor Scale; Cottony Maple Scale; European Fruit Lecanium; Florida Red Scale; Greedy Scale;**

Latania Scale; Green Shield Scale; Olive Parlatoria; Oystershell Scale; Peach Scale; San Jose Scale; Walnut Scale; Soft Scale.
Greenhouse Whitefly; Mealybugs; Root-knot Nematode.

ROSE-ACACIA (*Robinia hispida*)

Laburnum Aphid; Bean Aphid.

Silver-spotted Skipper (caterpillar).

ROSE-OF-SHARON (*Hibiscus syriacus*)

Melon Aphid; Laburnum Aphid—dark aphids, very common and numerous on ends of branches and twigs.
Black Scale.

Japanese Beetle—feeds on flowers and foliage.

ROYAL POINCIANA

Lesser Snow Scale.

RUBBER PLANT (*Ficus elastica*)

Oleander Scale—pale yellow; **Black Scale; Cyanophyllum Scale; Florida Red Scale; Soft Scale.**
Long-tailed Mealybug; Greenhouse Thrips; Banded Greenhouse Thrips; Dracaena Thrips.

RUDBECKIA (Coneflower)
(See also Goldenglow)

Lily Aphid; Goldenglow Aphid.
Six-spotted Leafhopper.

RUTABAGA
(See also Turnip)

Turnip Aphid—gray; common.

SAGE, BLACK, WHITE (*Audibertia*)

Greenhouse Whitefly; Glacial Whitefly; Iridescent Whitefly.
Yucca Mealybug; Olive Parlatoria; Greedy Scale.

SAGE, SCARLET, BLUE (*Salvia*)

Tarnished Plant Bug; Grape Leafhopper.
Foxglove Aphid; Leaf Nematode.

Yellow Woolly Bear.

SALSIFY

Tarnished Plant Bug.

Yellow Woolly Bear (caterpillar).

SAPODILLA

Florida Wax Scale; Lesser Snow Scale; Green Shield Scale.

SASSAFRAS

Japanese Beetle—numerous on foliage.
Hickory Horned Devil (caterpillar); **Io Moth; Polyphemus Moth; Promethea Moth.**

Oystershell Scale; San Jose Scale.

SCABIOSA

Fuller Rose Beetle.

Six-spotted Leafhopper.

SCHIZANTHUS

Six-spotted Leafhopper.

SEA GRAPE (*Coccolobis uvifera*)

Florida Wax Scale; Green Shield Scale.

SEDUM

Melon Aphid; Green Peach Aphid; Sedum Aphid (latter not described in Bug section).
Greedy Scale.

SENECIO

Painted Beauty (caterpillar).

SHADBUSH OR SERVICEBERRY OR JUNEBERRY (*Amelanchier*)

Woolly Elm Aphid; Pear Leaf Blister Mite; Oystershell Scale.

Shadbush Leaf Miner; Apple Curculio; Pear Slug; Fall Webworm; Gypsy Moth.
Pear Borer; Roundheaded Apple Tree Borer; Lesser Peach Borer; Shot-hole Borer.

SHALLOT

Lesser Bulb Fly.

SHEPHERDIA

Artichoke Aphid.

SILVER LACE VINE (*Polygonum auberti*)

Japanese Beetle; Flea Beetles.
Corn Root Aphid.

SILVER THORN

Peach Scale; Purple Scale; San Jose Scale; Oystershell Scale.

SILVER TREE (*Leucadendron argenteum*)

Greedy Scale.

SILVER VINE (*Actinidia*)

Greenhouse Orthezia; San Jose Scale.
Cats—very fond of this vine, may need to protect with wire.

SMILAX

Citrus Whitefly; Aphids.

SMOKETREE (*Cotinus*)

San Jose Scale.

Oblique-banded Leaf Roller.

SNAPDRAGON (Antirrhinum)

Cyclamen Mite—leaves, flowers deformed; **Common Red Spider.**
Snapdragon Lacebug; Red and Black Stinkbug.
Green Peach Aphid; Melon Aphid; Root-knot Nematode.

Celery Leaf Tier; Snapdragon Plume Moth; Verbena Budworm.
Garden Centipede; Slugs.

SNOWBALL (Viburnum)

Snowball Aphid—very common; curls new foliage; **Currant Aphid.**
San Jose Scale; Putnam Scale; Lightning Leafhopper; Tarnished Plant Bug.

Asiatic Garden Beetle.

SNOWBERRY (*Symphoricarpos*)

Honeysuckle Aphid; Snowberry Aphid; Lily Aphid.
San Jose Scale; Glacial Whitefly.

Snowberry Clearwing (moth).

SNOWDROP (*Galanthus*)

Stem and Bulb Nematode; Narcissus Bulb Fly.

SOAPBUSH or SOAPBERRY (*Sapindus*)

Ceanothus Aphid.

SOURBERRY (*Rhus integrifolia*)

Hemispherical Scale.

SOYBEAN

Velvetbean Caterpillar—may defoliate in Gulf states; **Green Clover Worm; Garden Webworm; Corn Earworm.**

Japanese Beetle—makes lace of foliage; **Mexican Bean Beetle**—not so serious as on other beans; **Bean Leaf Beetle; Blister Beetles; Locust Leaf Beetle; Clover Root Curculio.**

Red-legged Grasshopper.

Greenhouse Whitefly.

SPANISH NEEDLE

Yellow Woolly Bear (caterpillar).

SPINACH

Spinach Leaf Miner—tan blotches on leaves; rather common; **Serpentine Leaf Miner.**

Celery Leaf Tier; Beet Webworm; Cabbage Looper.

Spinach Flea Beetle; Potato Flea Beetle—small holes in foliage.

Blister Beetles; Beet Leaf Beetle; Spinach Carrion Beetle; Vegetable Weevil.

Armyworms; Cutworms; Grasshoppers; Seed-corn Maggot; Garden Springtail.

Melon Aphid; Bean Aphid; Green Peach or **Spinach Aphid.**

SPIREA

Spirea Aphid—green, common; **Root-knot Nematode.**

Spirea Scale; Oystershell Scale; Cottony Maple Scale.

Spirea Leaf Roller; Saddled Prominent (caterpillar).

Black Vine Weevil.

SPRUCE (*Picea*)

Eastern Spruce Gall Aphid—pineapple-shaped galls at base of twigs of Norway spruce; **Blue Spruce Gall Aphid**—large, light-colored galls at ends of twigs; **Pine Leaf Aphid; Spruce Aphid.**

Spruce Mite—needles grayish, webby; common pest.

Pine Needle Scale; Spruce Bud Scale; Pine Spittle Bug.

Spruce Budworm—needles webbed together; important pest; **Spruce Leaf Miner**—also webs needles.

Spruce Sawfly; European Spruce Sawfly.

White-pine Weevil; Pales Weevil.

Eastern Spruce Beetle; Englemann Spruce Beetle; Black Turpentine Beetle; Douglas-fir Engraver; Pine Bark Beetle; Northeastern Sawyer; Red Turpentine Beetle; Southern Pine Beetle; White-pine Cone Beetle.

Gypsy Moth; Imperial Moth; Spruce Epizeuxis (moth).

Fir Flatheaded Borer; Hemlock Borer.

Squash

Squash Borer—vines wilt; common; serious; **Melon Worm; Pickleworm; Corn Earworm; Yellow Woolly Bear** (caterpillar).

Squash Beetle; Spotted Cucumber Beetle; Striped and **Western Striped Cucumber Beetles; Imbricated Snout Beetle; Spinach Carrion Beetle.**

Tobacco Flea Beetle; Garden Springtail; Squash Root Maggot.

Squash Bug—flat brown bug sucks sap, vines may die; **Southern Squash Bug; Harlequin Bug.**

Melon Aphid; Potato Aphid; and other species; **Beet Leafhopper.**

Greenhouse Whitefly—often abundant; **Onion Thrips; Western Flower Thrips; Root-knot Nematode.**

Do not use sulfur on squash.

Squill

Tulip Bulb Aphid.

Stock (*Mathiola*)

Striped Flea Beetle; Western Black Flea Beetle; Western Striped Flea Beetle.

Diamondback Moth; Garden Springtail.

Aphids; Mexican Mealybug.

Strawberry

Strawberry Weevil—injures buds; **Rough Strawberry Weevil; Strawberry Root Weevil; Black Vine Weevil**—grubs feed on roots.

Strawberry Crown Borer; Strawberry Crown Moth; Strawberry Rootworm.

Strawberry Leaf Roller; Western Strawberry Leaf Roller; Obliquebanded Leaf Roller; Strawberry Sawfly; Celery Leaf Tier; Garden Webworm; Green Clover Worm.

Strawberry Flea Beetle; Pale-striped Flea Beetle.

Strawberry Leaf Beetle; Alfalfa Snout Beetle; Fuller Rose Beetle; Ten-lined June Beetle; Rose Chafer; Rose Leaf Beetle; Darkling Beetle; Cowpea Curculio.

Strawberry Fruitworm.

Millipedes; Field Cricket; Mole Cricket; Fire Ant; European Earwig.

Strawberry Spittle Bug—white frothy masses, may be quite injurious; **Leaf-footed Plant Bug; Negro Bug; Tarnished Plant Bug; Grape Mealybug; Pameras**—cause hard berries.

Cyclamen Mite—known as crown mite on strawberries; serious; **Common Red Spider.**

Strawberry Aphid; Melon Aphid; Strawberry Root Aphid.

Rose Scale; San Jose Scale; Soft Scale; Root-knot Nematode.

The most important way to control strawberry pests is to buy clean stock. Use poison bait for weevils; rotenone dust for spittle bugs and many other leaf-chewing or sucking insects.

Strawflower (*Helichrysum bracteatum*)

Six-spotted Leafhopper.

Strelitzia (Bird-of-Paradise)

Greedy Scale; Citrus Mealybug; Long-tailed Mealybug.

Sugar-bush (*Rhus ovata*)

Christmasberry Thrips.

Sumac (*Rhus*)

Sumac Psyllids—dark gray or black with white fringe.

San Jose Scale; Black Scale; Cottony Maple Scale; Hemispherical Scale; Lesser Snow Scale.

Aphid Gall and **Mites**—not described in Bug section.

Potato Flea Beetle.

Hickory Horned Devil; Oblique-banded Leaf Roller.

Currant Borer.

Sunflower (*Helianthus*)

Melon Aphid; Potato Aphid; Dogwood Aphid; Hop Aphid; Leaf Curl Plum Aphid.

Four-lined Plant Bug; Harlequin Bug; Say Stinkbug; Southern Green Stinkbug; Pumpkin Bug; Tarnished Plant Bug; Citrophilus Mealybug.

Cottony-cushion Scale.

Sunflower Maggot—stems may break over.
Yellow Woolly Bear; Painted Lady (caterpillar); **Oblique-banded Leaf Roller; Corn Earworm.**
Potato Flea Beetle; Pale-striped Flea Beetle; Carrot Beetle; Western Striped Cucumber Beetle.

Sweet Gum (*Liquidambar*)

Cottony-cushion Scale; English Walnut Scale.

Bagworm; Fall Webworm; Forest Tent Caterpillar.
Luna Moth; Promethea Moth; Polyphemus Moth; Azalea Sphinx.

Sweet Olive or Tea Olive (*Osmanthus*)

Camphor Scale; Chaff Scale.

Sweet Pea (*Lathyrus odoratus*)

Pea Aphid; Potato Aphid; Corn Root Aphid; Tarnished Plant Bug.
Common Red Spider—leaves yellowing, mealy; prevalent.
Onion Thrips; Western Flower Thrips; Root-knot Nematode.

Spotted Cucumber Beetle; Pea Moth; Serpentine Leaf Miner; Celery Leaf Tier; Corn Earworm.
Garden Centipede; Sowbugs.

Sweet Potato

Potato Aphid; Banded Greenhouse Thrips; Whiteflies.
Bean Leafhopper; Garden Flea Hopper.

Argus and **Two-striped Tortoise Beetles; Blister Beetles.**
Sweetpotato Flea Beetle; Sweetpotato Weevil; White-fringed Beetle.
Yellow-striped Armyworm; Southern Armyworm; Fall Armyworm; Hornworms.
Seed-corn Maggot; Sweetpotato Leaf Roller; Yellow Woolly Bear (caterpillar).

Sweet William (*Dianthus*)

Six-spotted Leafhopper—carries aster yellows virus.

Sycamore or Plane Tree, Oriental Plane, London Plane (*Platanus*)

Sycamore Lacebug—leaves whitened; **Sycamore Plant Bug.**
Sycamore Aphid; Hickory Aphid.
Sycamore Scale—serious on Oriental plane; **Oystershell Scale; Cottony Maple Scale; Black Scale; Grape Scale; Terrapin Scale.**
Southern Red Mite; Two-marked Treehopper; Mulberry Whitefly.

White-marked Tussock Moth; Sycamore Tussock Moth; Imperial Moth; Io Moth; Oriental Moth.

Bagworm; Puss Caterpillar; Hickory Horned Devil; Omnivorous Looper; Fall Webworm.

Flatheaded Apple Tree Borer; Pacific Flatheaded Borer; Pigeon Tremex.

Syngonium

Greenhouse Thrips.

Tamarisk

Oystershell Scale; Latania Scale.

Tangerine

(See also Citrus)

Black Scale; California Red Scale.
Citrus Rust Mite; Leaf-footed Bug.

Fuller Rose Beetle.

Taxus

(See Yew)

Tea (*Thea sinensis*)

California Red Scale; Barnacle Scale; Florida Wax Scale; Green Shield Scale.

Tecoma

Omnivorous Looper.

Thistle

Bean Aphid; Artichoke Aphid; Melon Aphid; Thistle Aphid.
Four-lined Plant Bug; Leaf-footed Bug.

Painted Beauty and **Painted Lady**—caterpillars.
Oblique-banded Leaf Roller; Celery Leaf Tier.

Thorns

(See Hawthorn)

Thunbergia

Lesser Snow Scale.

Thyme

Ground Mealybug.

Tomato

Potato Flea Beetle—small, black, causes minute shot holes, loss of vigor; very common on plants set out in spring; **Pale-striped Flea Beetle; Western Potato Flea Beetle; Tobacco Flea Beetle.**

Tomato Hornworm; Tobacco Hornworm; White-lined Sphinx (moth)—all large green caterpillars with horns; may devour foliage; **Cabbage Looper; Fall Armyworm; Semi-tropical Armyworm.**

Corn Earworm—the tomato fruitworm; **Tomato Pinworm; Potato Tuber Worm.**

Blister Beetles; Colorado Potato Beetle; Fig Beetle; Spotted Cucumber Beetle; Vegetable Weevil; Darkling Ground Beetle.

Cutworms—frequently cut off young plants; **Garden Springtail; Slugs.**

Stalk Borer; Garden Centipede; Millipedes; Field Cricket.

Green Peach Aphid and **Potato Aphid**—both common and injurious; leaves curled, yellowed, plant weakened.

Greenhouse Whitefly—tiny white moth-like insects flying out in clouds from underneath leaves when disturbed.

Tomato Russet Mite; Cyclamen Mite; Common Red Spider.

Garden Flea Hopper—minute, black; may suck seedlings; **Beet Leafhopper.**

Tomato Psyllid—plants deformed, look diseased.

Onion Thrips; Banded Greenhouse Thrips; Western Flower Thrips; Florida Flower Thrips.

Big Convict Bug; Eggplant Lacebug; Brown Stinkbug; Green Stinkbug; Leaf-footed Bug; Pumpkin Bug.

Tomatillo

Tomato Russet Mite.

Trumpet-Creeper or Trumpet Vine (*Campsis*)

Citrus Whitefly; Olive Parlatoria (scale).

Lightning Leafhopper.

Tuberose (*Polianthes tuberosa*)

Root-knot Nematode.

Tulip

Green Peach Aphid; Tulip Bulb Aphid—white, woolly on bulbs.

Putnam Scale; Stem and Bulb Nematode—plants twisted and deformed; **Bulb Mite.**

Narcissus Bulb Fly—large maggot in rotting bulb.

Millipedes.

Tuliptree (*Liriodendron*)

Tuliptree Aphid—green, secretes much honeydew; covered with sooty mold.

Tuliptree Scale—large, hemispherical; **Oystershell Scale; Willow Scale.**

Tuliptree Spot Gall—circular brown spots on leaves, which may drop.

June Beetle; Promethea Moth.

Tung-oil-Tree

Olive Parlatoria.

Tupelo or Sour-Gum or Pepperidge (*Nyssa*)

Tupelo Leaf Miner or **Sour-Gum Case Cutter**—cuts pieces from leaves.

Azalea Sphinx (moth); **Borer**—not described.

Sour Gum Scale—not described; **San Jose Scale.**

Turnip

Turnip Aphid—grayish; may be serious; **Cabbage Aphid; Potato Aphid.**

Onion Thrips; Green Stinkbug; Harlequin Bug; Tarnished Plant Bug.

Cabbage Maggot—wilts seedlings; **Seed-corn Maggot.**

Pale-striped and **Sinuate-striped Flea Beetles; Western Black** and **Western Striped Flea Beetles.**

Red Turnip Beetle—bright red and black; **Asiatic Garden Beetle; Striped Blister Beetle; Vegetable Weevil; Cabbage Curculio.**

Cabbage Looper; Yellow Woolly Bear (caterpillar); **Diamondback Moth; White-lined Sphinx** (moth); **Imported Cabbage Worm.**

Serpentine Leaf Miner; Lesser Cornstalk Borer; Millipedes.

Umbrella Plant (*Cyperus*)

Citrus Mealybug; Long-tailed Mealybug.

Citrus Thrips; Citrus Whitefly.

Umbrella Tree (*Magnolia tripetala*)

Greedy Scale; Oleander Scale; Citrus Thrips; Citrus Whitefly.

Velvetbean

Velvetbean Caterpillar.

White-fringed Beetle.

Verbena

Verbena Leaf Miner—blotches in leaves; practically inevitable in gardens.

Verbena Budworm—bores in new shoots, causing withering.

Omnivorous Looper; Oblique-banded Leaf Roller; Yellow Woolly Bear (caterpillar); **Garden Webworm.**

Gray Blister Beetle.

Leaf Nematode—brown areas on leaves.
Green Peach Aphid; Foxglove Aphid; Melon Aphid.
Tarnished Plant Bug; Snapdragon Lacebug.
Cyclamen Mite; Broad Mite; Common Red Spider; Greenhouse Thrips.
Cottony-cushion Scale; Greenhouse Orthezia.

VERONICA

Checker Spot or **Chalcedon** (caterpillar).

VIBURNUM

(See also Snowball)

Snowball Aphid; Ivy Aphid; Grapevine Aphid.
Chaff Scale; Cottony-cushion scale; Cottony Maple Scale; Olive Parlatoria; Oystershell Scale.
Citrus Whitefly; Greenhouse Thrips; Lightning Leafhopper.

Potato Flea Beetle.

VIOLET

Common Red Spider—very prevalent; **Cyclamen Mite; Citrus Mealybug.**
Violet Aphid; Red Violet Aphid; Green Peach Aphid; Foxglove Aphid.
Root-knot Nematode; Leaf Nematode.

Violet Sawfly—blue-black larvae feeding on foliage at night.
Violet Gall Midge; Potato Flea Beetle; Omnivorous Looper; Celery Leaf Tier.
Avoid the use of nicotine on violets; they are often injured by it.

VIRGINIA CREEPER (*Parthenocissus*)

Virginia Creeper Leafhopper; Grape Leafhopper; Three-banded Leafhopper—all turn foliage grayish and are common; **Rusty Plum Aphid.**
Cottony Maple Scale; Peach Scale; Oystershell Scale; San Jose Scale; Olive Parlatoria.

Japanese Beetle—new leaves always chewed to lace; **Rose Chafer; Grape Flea Beetle.**
Eight-spotted Forester (caterpillar); **Yellow Woolly Bear; Achemon Sphinx** (moth).

WALLFLOWER (*Cheiranthus*)

Lily Aphid.

Red Turnip Beetle; Western Striped Flea Beetle; Diamondback Moth.

Walnut

Walnut Aphid; Hickory Aphid; Walnut Lacebug.
Walnut Blister Mite; European Red Mite; Southern Red Mite.
Walnut Scale; Black Scale; California Red Scale; Calico Scale; Citricola Scale; Cottony-cushion Scale; Greedy Scale; Scurfy Scale; Putnam Scale; Oystershell Scale; White Peach Scale.
Citrophilus Mealybug; Grape Mealybug.

Walnut Husk Fly; Black Walnut Curculio; Butternut Curculio or **Walnut Weevil; Codling Moth.**
Walnut Caterpillar—black with white hairs; **Hickory Horned Devil; Omnivorous Looper; Orange Tortrix; Red-humped Caterpillar; Yellow-necked Caterpillar; Butternut Woolly Worm; Fruit Tree Leaf Roller; Fall Webworm.**
Hickory Tussock Moth; Western Tussock Moth; Luna Moth.
Strawberry Leaf Beetle; Strawberry Rootworm.
Hickory Bark Beetle; Brown Wood Borer; California Prionus; Nautical Borer; Painted Hickory Borer; Tiger Borer; Twig Pruner; Subterranean Termite.

Wandering Jew (*Tradescantia*)

Orange Tortrix (caterpillar); **Celery Leaf Tier; Morning Glory Leaf Cutter.**

Citrus Mealybug; Chaff Scale; Root-knot Nematode.

Watercress

Bean Aphid; Spinach Aphid.

Watercress Leaf Beetle; Flea Beetles; Diamondback Moth.
Watercress Sow Bug.

Water-Hyacinth

Soft Scale.

Waterlily (*Nymphaea*)

Waterlily Aphid; Corn Leaf Aphid.

Waterlily Beetle; False Leaf-mining Midge.

Watermelon

(See also Melon)

Melon Worm; Pickleworm.
Potato Flea Beetle; Striped Cucumber Beetle; Squash Beetle.
Serpentine Leaf Miner; Camel Cricket; Millipedes.

Melon Aphid—common and serious; **Greenhouse Whitefly.**
Black Scale; California Red Scale.

WATER-PLANTAIN

Waterlily Aphid.

WEIGELA

Four-lined Plant Bug; Comstock Mealybug.

WILLOW

Imported Willow Leaf Beetle—leaves skeletonized by slug-like, dark larvae and metallic-blue beetles; prevalent; **Japanese Beetle**—feeds ravenously on willow foliage; **Alder Flea Beetle; Cottonwood Leaf Beetle; June Beetle; Rose Leaf Beetle; Willow Flea Weevil.**
Willow Sawfly; Poplar Sawfly.
Poplar and Willow Borer—may be serious; **Cottonwood Borer; Flatheaded Apple Tree Borer; Pacific Flatheaded Borer; Bronzed Birch Borer; Brown Wood Borer; Carpenter Worm; Leopard Moth.**
Bagworm; Giant Hornet.
California Tent Caterpillar; Eastern Tent Caterpillar; Forest Tent Caterpillar; Hemlock Looper; Mourning Cloak (caterpillar); **Omnivorous Looper; Orange Tortrix; Poplar Tent Maker; Red-humped Caterpillar; Walnut Caterpillar; California Casebearer; Fruit Tree Leaf Roller.**
Brown-tail Moth; Buck Moth; Cecropia Moth; Oriental Moth; Gypsy Moth; Horned Moth; Io Moth; Luna Moth; Satin Moth; Rusty Tussock Moth; White-marked Tussock Moth.

Willow Scale; Oystershell Scale; Scurfy Scale; Black Scale; California Red Scale; Cottony-cushion Scale; Cottony Maple Scale; European Fruit Lecanium; Greedy Scale; Obscure Scale; Putnam Scale; Lecanium Scale; Soft Scale; Terrapin Scale.
Hickory Aphid; Willow Cone Gall; Two-marked Treehopper.
Willow Lacebug; Citrus Thrips; Pear Thrips.
Root-knot Nematode.

WISTERIA

Silver-spotted Skipper (caterpillar); **Sweetpotato Leaf Beetle.**
Black Vine Weevil; Fall Webworm.

Lightning Leafhopper; Japanese Mealybug.
Lesser Snow Scale; Mining Scale; Peach Scale.

Witch-Hazel (*Hamamelis*)

Witch-hazel Cone Gall; Witch-hazel Spiny Gall.
Saddled Prominent (caterpillar).

Yam Vine (*Dioscorea*)

Cloudy-winged Whitefly.

Yew (*Taxus*)

Taxus Mealybug—white, oval bodies often covering main trunk, branches; **Grape Mealybug.**
Purple Scale; Oleander Scale; California Red Scale.

Black Vine Weevil—shrubs suddenly turn brown and die from grubs working at roots; **Termites.**

Yucca

Yucca Mealybug; Citrus Mealybug; Aphids.
Oleander Scale; Oystershell Scale; California Red Scale.

Yucca Moth; Common Stalk Borer.

Zinnia

Japanese Beetle—numerous on flowers and foliage; **Asiatic Garden Beetle**—may eat foliage at night; **Blister Beetles**—feed on flowers; **Spotted Cucumber Beetle**—also feeds on flowers; **Flea Beetles.**
Stalk Borer.

Four-lined Plant Bug; Tarnished Plant Bug; Bean Aphid.
Six-spotted Leafhopper—transmits aster yellows; **Red-banded Leafhopper; Leaf Nematode.**
Composite Thrips; Long-tailed Mealybug; Broad Mite; Cyclamen Mite.

Chapter VII

IT'S NOT SO BAD AS IT SEEMS

BY NOW HUNDREDS AND HUNDREDS OF INSECTS ARE MILLING AROUND IN my head, and I know that if you even skim over lightly the preceding two chapters you will be more than discouraged. So I sternly remind myself—and you—that the situation is not one tenth so bad as it appears.

In the first place, none of us have all these plants to worry about and we know from experience that a lot of those we do have get along quite well when left to shift for themselves.

In the second place, probably not more than half the insects listed would ever appear in any one garden, and of those that might come to visit perhaps less than a fourth would call for control measures beyond general sanitation.

In the third place, insects are spread out over the season; we have to worry about only a few at a time.

In the fourth place, the insects which do appear at the same season do not necessarily require separate treatments. Most of them can be grouped and controlled with one or two spray mixtures.

In the fifth place, a goodly number of the thousand insects described here and many of those which will appear in your garden are friends—such good friends that they measurably reduce the treatments required for harmful insects.

Lastly, no one expects you to remember the description and life history of those insects which you do have. That comes slowly, a few at a time. Over a period of years you will learn to recognize, unmistakably, your common pests—as much from their effect on the plants as from their own appearance. Not even a lifelong entomologist recognizes many insects outside the particular group he works on. A spider specialist, or one who identifies species of Lepidoptera—moths and butterflies—doesn't

have the slightest idea what you are talking about when you ask about that common little snout beetle that chews up helenium all summer, or whether the red aphid that makes its home on the underside of delphinium leaves is the same one that covers the stems of goldenglow. So don't worry about not recognizing pests; with a little close observation in your garden you'll soon know more about insects in general than the specialist does. And don't try to remember too many details all at once. Use this book as a reference, to check on your enemies if and when you meet them.

I cannot give a calendar to cover the insects and climate in the garden of every reader, but perhaps a rough outline, hitting the high spots of what I do in my own garden and for my clients, may help you make your own calendar. I strongly advise keeping records in one of those five-year diaries which tell at a glance the earliest date you can expect any given insect and the date you can expect it in an average season.

I went on record in *The Plant Doctor* to the effect that an hour a week from March to November was enough to keep the average suburban garden reasonably healthy. I was talking then about shrubs, vines, and flowers, but I think that that hour can be stretched to include a few vegetables. Naturally, if your happiest moments come from exhibiting blue-ribbon fruits and vegetables at the harvest show you will have to put in some extra time to bring them to perfection. The hour a week merely keeps your garden a pleasant place to live in, with foliage and flowers not too visibly rotting or blighting or riddled with holes, and with a few vegetables and fruits that are edible, though not perfect.

In doctoring for clients I take on a garden by the season and go as often as it seems necessary, but I charge for my time by the hour and make no pretense of controlling all possible insects and diseases. I tell my clients frankly that it will not pay them to have me spend time on a lot of unimportant pests or plants which may require several different spray mixtures, with many minutes lost in making up the sprays and in rinsing the sprayer between operations. And I think that is a good rule for you to adopt in your own garden. Ask yourself if the results you expect will be worth the effort expended. If not, put the time on something more important.

A Plant Doctor's Calendar

MARCH

DORMANT SPRAYING

Experience in the suburban New York area has taught me that it is seldom possible to start dormant oil spraying before March 24. The temperature must be 45° F. or above and not likely to drop below freezing for 24 hours. During the last week in March I spray lilacs as rapidly as possible, before the buds break, and usually euonymus and bittersweet at the same time, for there is seldom a garden that does not have scale on all three. In special cases other shrubs are sprayed.

OTHER SPRAYING

In an early season tulips and peonies are starting through the ground and get sprayed with bordeaux mixture for botrytis blight. The copper, however, may be quite injurious to tulips under some weather conditions, so I hope to test out Fermate.

SANITATION

Odd hours when it is too cold to spray are spent cutting out tent caterpillar egg masses, or maybe wiping out the wee caterpillars as soon as they hatch, or cutting out rust galls on cedars, or removing any old hollyhock leaves with rust, et cetera, et cetera.

APRIL

Roses are uncovered, pruned, and immediately sprayed with 1 to 9 lime-sulfur, which gives a head start on black spot as well as controlling cankers and scales.

Hollyhocks are dusted with sulfur-lead arsenate to control slugs and rust.

Delphiniums are sprayed with a strong solution of rotenone, and this is repeated weekly, to control mites. Seriously infested plants are removed and burned.

Peonies, Tulips sprayed to prevent botrytis blight.

Evergreens are given a dormant spray before April 10 to 15, depending on the season. Miscible oil at a 1 to 25 dilution, plus nicotine, goes on spruce with aphid galls, pines with pine-needle scale; lime-sulfur 1 to 10 on junipers for scale.

Fruit Trees may have a delayed dormant spray early in April.

Cabbages and Broccoli are set out in tar-paper squares to prevent maggots, and surrounded with a few moth balls to keep off the rabbits.

Seeds are treated with Spergon or Cuprocide or Arasan before planting to prevent damping off and other diseases.

Pines are inspected the last week in April to see if the sawfly eggs are hatching on the needles or if there are a few yellow needles at the tip, signs that the tiny, well-camouflaged gangsters are already working. Ornamental pines are then thoroughly sprayed with a fairly heavy mixture of lead arsenate, with nicotine added if the larvae are already chewing.

MAY

Roses get the first of their weekly summer treatments as soon as they come into full leaf—sometimes the end of April, usually the first of May. For my clients—at least for the present—this means Triogen except on those rose varieties which are so allergic to copper that their leaves are covered with red spots or drop. These varieties, which are seldom hybrid teas, either get along untreated or have a sulfur lead-arsenate dust. Triogen controls rose slugs, aphids, leaf hoppers, beetles, black spot, and mildew. Roses in my own garden are always under experiment with various fungicides, insecticides, and combinations. This year I shall certainly try out the new combination of DDT, Rotenone, Fermate, and Sulfur, but from trials with Fermate and sulfur the last two years I expect I shall not enjoy using the new combination. I don't like the smell of Fermate, I hate getting it on my hands and arms and clothes, sometimes up my nostrils and in my hair, and I don't much like its appearance on lovely rose petals, though I have little objection to it on foliage. But Fermate does an excellent job of controlling black spot and I'll probably use it more widely in the future. It does not, however, control mildew, and my Fermate-dusted beds, even used with sulfur, had almost as much mildew as the untreated "check" rose beds.

I am "sold" on the idea of DDT for rose midge, but I want another season's experimenting before I use it too widely for clients, especially in gardens where red spider has been bothersome, for wherever DDT has been tried it has definitely enhanced the mite problem.

Other Ornamentals are also sprayed with Triogen, if they happen to need any of its ingredients, for it saves time in making up separate mixtures. It is helpful early in the spring in controlling flea beetles on

forget-me-nots; often used as edging or groundcover in rose beds. But I should like to register a protest against the habit of some gardeners of growing an edging of parsley around a rose bed, or putting a few clumps of mint in one corner. Never mix edibles with an ornamental which has to be sprayed with a poison every week. Triogen controls aphids on almost any plant and keeps helenium snout beetles more or less subdued, but is less effective than sulfur-and-lead-arsenate dust for hollyhocks, or a rotenone spray for delphiniums. Rotenone dust is used on all ornamentals plagued by four-lined plant bugs.

Boxwood. Sometime before the middle of May, this year, boxwood is going to get a dose of DDT, and my clients and I are going to be more than grateful to it (I hope). Now the promise of controlling this important pest with just one application of DDT seems almost too good to be true. During the war it was impossible to get enough gasoline to keep going around putting on molasses and nicotine for the boxwood leaf miner while the flies were laying their eggs, and all the bushes have visibly suffered.

Vegetables are most easily kept pest-free by rotenone dust, though cucumbers and their relatives are set out under Hotkaps and dusting started only when the vines are too big for the cover. Currants, too, get rotenone for aphids and sawfly larvae.

Fruit Trees are not in my regular schedule, for I cannot guarantee results for the time I have to spend. When a client has only 1 or 2 small fruit trees I do put on a calyx spray, and another about 2 weeks later, with the understanding that it will keep the trees looking ornamental with foliage unchewed by tent caterpillars and cankerworms, but may not be enough to prevent wormy fruit. I try, usually unsuccessfully, to convince clients having trees sprayed by others that a May application of lead arsenate cannot possibly control railroad worms or apple maggot working in July, and I also try, sometimes successfully, to get the arborist doing the spraying in May to add nicotine for the control of apple redbug which happens to be serious in my town.

Shade Trees. With every means at my disposal I encourage clients to have their elms sprayed for cankerworms and more particularly for elm leaf beetles; and, in some seasons, to have oaks sprayed for cankerworms. If it is a question of expense I beg them to fire me and put all the garden budget into having elms sprayed by a competent arborist with a power sprayer. I feel very strongly on this point. Nobody cares much if you lose one rosebush or a chrysanthemum or a delphinium; the whole town cares if your elm dies.

JUNE

Roses may need special treatment—tartar emetic or Salp—for thrips in addition to the regular spraying schedule.

Lacebugs are out on azaleas, rhododendron, sometimes laurel, calling for nicotine sulfate and soap—a long, unpleasant job on hot days.

Chinch Bugs are renewing activity in lawns. They get DDT.

Rose Chafers are feeding on roses and peonies, but not so seriously as farther north. Triogen works well enough here.

Iris has been having borer trouble and rot. It gets divided and a bath of bichloride of mercury whenever I have time, but as soon as possible after flowering.

Pines may have to be sprayed with lead arsenate for webworms, which work later than the sawflies. All shoots infested with shoot moth are broken off and burned by the first week in June.

Japanese Beetles start to emerge about the third week, just as four-lined plant bugs are signing off. Susceptible shrubs and vines are given a good coating of lead arsenate and flour.

Euonymus at the very end of June may be covered with young crawlers of euonymus scale. I put on a summer oil on a day that is cloudy and not too hot. The vines are always climbing up the front of houses and I seem inevitably to arrive just after the windows have been washed.

Phlox gets dusted with sulfur to control mildew and red spiders.

Vegetables continue to get rotenone, with special emphasis on beans for Mexican bean beetles, and corn for borers.

JULY

Grapes and sometimes raspberries and blackberries get the first of weekly treatments with Jap-Ro-Cide, Japellent, or some other special rotenone beetle spray. In one garden it goes on a quince tree to keep that foliage ornamental; in another on 2 or 3 peaches, and on an ornamental plum which lead arsenate defoliates completely.

Virginia Creeper and similar vines have to have the new growth kept sprayed even though they had a strong dose of lead arsenate at the end of June.

Roses, Marigolds, Zinnias, Chrysanthemums, and some other ornamentals continue to get Triogen for beetles, aphids, and other pests.

Dahlias may need a separate spray for leafhoppers; DDT may do this job.

Azaleas are sure to need nicotine sulfate for another brood of lacebugs.
Gladiolus probably has to have tartar emetic or Salp for thrips.

AUGUST

Lawns probably need another treatment for chinch bugs—second brood; perhaps digger wasps are out.
Lilacs can be sprayed or dusted for mildew, though it scarcely pays; Vespa hornets on lilacs are more worthy of attention.
Blister Beetles become a problem on Japanese anemones and asters.
Delphinium still gets sprayed for mites and probably aconite needs the same treatment.

SEPTEMBER

It is time to stop spraying grapes, but marigolds need beetle protection all through the month; and roses need spraying until the middle of October or later. Leafhoppers are serious on roses, and on many of the vines, all fall. Many vegetables still need dusting with rotenone.

OCTOBER

This is cleanup month. Peonies get cut to the ground, old foliage is removed from iris, old hollyhock, delphinium, dahlia, corn, and other stalks are burned to get rid of borers; all old plant remains are taken out of the vegetable garden. Roses are usually sprayed until the third week.

NOVEMBER

Roses get put to bed, and I start pacifying editors, beginning with Fred Rockwell, who hounded me into writing

The Gardener's Bug Book

BIBLIOGRAPHY

THE PURPOSE OF THIS *Gardener's Bug Book* HAS BEEN TO COLLECT, CORrelate, and condense between two covers much scattered information on garden pests. As stated in the Introduction, I acknowledge a great debt to the authors of many books, circulars, and scientific articles. Listed below are some of the most-frequently consulted books in my plant doctor library—books which have been used in the preparation of this manuscript. In case you get so excited about insects you want to read further, brief comments are included to help you in the selection of More Books on Bugs.

CLAUSEN, CURTIS P. *Entomophagous Insects.* McGraw-Hill, New York, 1940.

Here are 688 pages about insects that live on other insects. The next time you think the world is made up of bugs aiming to devastate your garden, stop and think about how many more bugs are working for you.

COMSTOCK, JOHN HENRY, ANNA BOTSFORD COMSTOCK, and GLENN W. HERRICK. *A Manual for the Study of Insects.* 22d ed., Comstock, Ithaca, N. Y., 1938.

First written in 1894 to meet the needs of teachers when entomology was in its infancy, this classic, as revised by Dr. Herrick, is still used for training students and teachers, and as a source book for everyone.

DODGE, BERNARD O. and HAROLD W. RICKETT. *Diseases and Pests of Ornamental Plants.* Jaques Cattell, Lancaster, Pa., 1943.

This is the first large-scale attempt at bringing together diseases and pests of a large number of ornamentals grown in greenhouses and outdoors. It is based primarily on the plant varieties grown at the New York Botanical Garden, but it includes many pests common in other

parts of the country. If you want to look up specific insects rather than their host plants you must know their scientific names. Insects are indexed only by their Latin names, while plants are indexed under common names but treated in alphabetical order under their scientific names.

ENTOMA. *A Directory of Insect and Plant Pest Control.* 6th ed., 1945, publ. by Eastern Branch of the American Association of Economic Entomologists.

This directory of the different chemicals used in gardens, together with names of manufacturers, trade names, and much miscellaneous information, should be on the shelf of every dealer, every garden editor, every public library. I have made much use of *Entoma* in compiling this book of bugs.

ESSIG, E. O. *Insects of Western North America.* Macmillan, New York, 1926.

I can't conceive of gardening in the West without this book, which is still in print (I purchased my own copy fairly recently) and still is a mine of information about insects to be found in home gardens as well as on farms and in forest areas.

More than any other pest book I have seen, Dr. Essig's manual gives real lists of the host plants attacked by different insects. Ornamentals have full attention, and I have shamelessly borrowed from these lists in compiling my own, for I certainly do not know that much about western insects. I hereby acknowledge a very great debt to Dr. Essig.

ESSIG, E. O., and W. M. HOSKINS. *Insects and Other Pests Attacking Agricultural Crops.* Cal. Agric. Ext. Ser. Circ. 87, 1944.

Circulars are supposed to be excluded from this list, but here is practically a book which you who garden in California can have for the asking from your College of Agriculture at Berkeley. Control measures are brought right up to date and some ornamentals are included. Asters are squeezed in between asparagus and avocado, chrysanthemums and cineraria between cherry and citrus fruits.

FELT, EPHRAIM PORTER. *Our Shade Trees.* Orange Judd, New York, 1938.

The title of the first chapter, "Shade Trees and Men," sets the pace of a book devoted to the appreciation of trees. We learn with some astonishment of the actual cash value of our trees, but that is only the beginning of what we get from them.

——— *Plant Galls and Gall Makers.* Comstock, Ithaca, N. Y., 1940.

Only for those really interested in the queer malformations caused by insects, for not many of the large number of gall makers are susceptible to economical control.

FELT, EPHRAIM PORTER, and H. HOWARD RANKIN. *Insects and Diseases of Ornamental Trees and Shrubs.* Macmillan, New York, 1932.

About the first book in my plant-doctor library, it has been in constant use ever since. Treating diseases as well as pests, and including some fruit trees, the discussion is often brief but much to the point. The country is covered fairly well with not too much bias toward eastern troubles.

FENSKA, RICHARD R. *Tree Experts' Manual.* De La Mare, New York, 1943.

There is everything here a tree expert needs to know and that a home owner should know before hiring a tree expert, written by a man who is himself a practicing arborist. The chapter on shade-tree laws alone is worth the price, should you ever have a dispute with a neighbor about a boundary tree.

FERNALD, H. T., and HAROLD H. SHEPARD. *Applied Entomology.* McGraw-Hill, New York, 1942.

A selected few important pests are discussed in clear detail. You may not find all the insects you are interested in, but there is valuable information about some, though not too much help on pests of ornamentals.

FREAR, DONALD, E. H. *Chemistry of Insecticides and Fungicides.* Van Nostrand, New York, 1942.

If you are chemically inclined this will give you the history of insecticides, how they are made and used.

FROST, S. W. *General Entomology.* McGraw-Hill, New York, 1942.

I discovered this book at our local public library only recently and wish I had known about it before. It is a good general text with standard illustrations.

HERRICK, GLENN W. *Insect Enemies of Shade-Trees.* Comstock, Ithaca, N. Y., 1935.

A really valuable book for anyone who owns one or more trees. Since it is limited to shade trees, there is space to go into life histories and diagnostic characters in detail and to include a fair selection of pests across the country. It will help you in authorizing spraying or other work to be done on your trees and it has helped me greatly in writing this book.

JAEGER, EDMUND C. *A Source-book of Biological Names and Terms.* Charles C. Thomas, Springfield, Ill., 1944.

It is a help in remembering scientific names of plants or insects to know where they came from. For instance, Hepatica, which has a liver-shaped leaf, takes its name from the Greek *hepat,* which means pertaining to or affecting the liver.

KENLY, JULIE CLOSSON. *Little Lives.* The story of the world of insects. Appleton-Century, New York, 1938.

A book for young people, but a painless way for anyone to learn about insects. I love the story of the blister beetle baby, and it only goes to show that some of our garden villains are helpful during at least part of their lives.

KING, ELEANOR, and WELLMER PESSELS. *Insect Allies.* Harper, New York, 1938.

I suspect this, too, was written for young nature lovers, but I highly commend it to all gardeners. It sent me to Enterprise, Alabama, to look at that fountain erected in "appreciation" of the boll weevil.

LAURIE, ALEX, and D. C. KIPLINGER. *Commercial Flower Forcing.* Blakiston, Philadelphia, 1944.

There is a chapter on diagnosing greenhouse ills which should be a great help to anyone owning a small greenhouse as well as to the commercial grower.

LEACH, JULIAN GILBERT. *Insect Transmission of Plant Diseases.* McGraw-Hill, New York, 1940.

Not too technical for the serious gardener, this book presents clearly the part insects play as vectors of plant disease and shows how they themselves cause disease symptoms.

LUTZ, FRANK E. *Field Book of Insects.* Putnam, New York, 1935.

This is the standard handbook for every budding entomologist. It is for identification, not life histories or control measures, but there are delightful observations interpolated between the keys.

——— *A Lot of Insects.* Entomology in a suburban garden. Putnam, New York, 1941.

The late Dr. Lutz loved insects, and you need his book as an antidote to Anthony Standen's *Insect Invaders.* Read the two together and you will keep the balance of nature we are always talking about. Incidentally, you will have a grand good time.

MATHESON, ROBERT. *Entomology for Introductory Courses.* Comstock, Ithaca, N. Y., 1944.

If you have never had any entomology and want to teach yourself, as I did, here is a fine way to get started. It is a readable textbook with the technical side kept to a minimum. It tells what insects are, how they look and act, and their relation to man; but it does not take up control measures.

METCALF, C. L., and W. P. FLINT. *Destructive and Useful Insects.* McGraw-Hill, New York, 1939.

I have already worn out two editions of Metcalf and Flint. It has been my bible for plant doctoring and writing for a dozen years, and

I owe more to it than I can ever adequately acknowledge. The material on ornamentals is rather limited, but everything else is there, with detailed life histories, distribution of pests, and plants attacked.

MCCLINTOCK, J. A., and WAYNE B. FISHER. *Spray Chemicals and Application Equipment.* Greenlee, Chicago, 1945.

A clear discussion of types of chemicals used for insecticides and fungicides, some manufacturing processes, and many photographs of sprayers and dusters.

PEAIRS, LEONARD MARION. *Insect Pests of Farm, Garden and Orchard.* Wiley, New York, 1941.

Here you can find almost any insect apt to be bothering a garden vegetable or fruit, usually accompanied by a good drawing or photograph. The first edition was written by E. Dwight Sanderson in 1921, and as it is still being brought up to date you can see how many farmers and gardeners refer to it.

PIRONE, P. P. *Maintenance of Shade and Ornamental Trees.* Oxford, New York, 1941.

Written for the arborist and his client, the homeowner, giving sound, readable information on the normal tree, transplanting, feeding, pruning, cavity treatment, and selection of street trees, followed by a list of common trees with some of their more important pests briefly treated. The latter section is more applicable to the East than to the country as a whole.

PYENSON, LOUIS. *Pest Control in the Home Garden.* Macmillan, 1944.

I never before met so much practical information in one slim book. Dr. Pyenson teaches plant protection at the State Institute of Applied Agriculture, Farmingdale, N. Y., and has learned to distill, from the vast store of general information, just what the practical gardener needs for his garden, fruits, and vegetables. The figures on calculating dosages and the dos and don'ts for spray mixtures are particularly valuable for amateurs. The photographs, all by the author, are splendid aids in recognition of pests.

QUAYLE, H. J. *Insects of Citrus and Other Subtropical Fruits.* Comstock, Ithaca, N. Y., 1941.

Detailed life histories, lists of food plants, and excellent photographs will help you if you garden in California or anywhere along the Gulf to Florida.

ROCKWELL, F. F., et al. *10,000 Garden Questions Answered.* American Garden Guild-Doubleday, Doran, New York, 1944.

About one tenth of these questions, your own home garden questions, are about insects.

SEYMOUR, E. L. D., Editor, *The Garden Encyclopedia.* Wm. H. Wise, 1936, and later editions.

This is still helpful, in lots of ways, whether checking on plants or insects.

SHEPARD, HAROLD H. *The Chemistry and Toxicology of Insecticides.* Burgess, Minneapolis, Minn., 1939, 1945.

This is another book for the gardener with chemical interests, but one which will also satisfy the average gardener's curiosity about such items as what Red Squill is, where it comes from, why it can safely be used for rats.

STANDEN, ANTHONY. *Insect Invaders.* Houghton Mifflin, Boston, 1943.

The author hates insects, as well he might, since he spends his life working out fumigants and other chemicals to control our most destructive pests. To really know how much trouble insects have caused in this world, by all means read Anthony Standen.

TEALE, EDWIN WAY. *Grassroot Jungles.* Dodd Mead, New York, 1937.

——— *Near Horizons.* The story of an insect garden. Dodd Mead, New York, 1942.

——— *The Boy's Book of Insects.* Blakiston, Philadelphia, 1943.

——— *The Lost Woods.* Dodd Mead, New York, 1945.

Reading Teale is to be transported to another world, and what he can do with a camera is sheer magic, whether he is photographing drama on a leaf in his own back yard or in the midst of a Florida swamp. Whenever you feel too discouraged about garden pests buy, beg, borrow, or steal one of Edwin Way Teale's books—any one will do—and regain your equilibrium. Required reading for all gardeners.

WATSON, J. R. *Florida Truck and Garden Insects.* Flor. Agric. Exp. Sta., Bull. 232, 1931.

This is another bulletin which is practically a book and which has helped me with pests in a region I have visited only twice, to date, though I expect to do better in the near future.

WESTCOTT, CYNTHIA. *The Plant Doctor.* Stokes, New York, 1937, 1940.

I have purposely refrained from checking up on my previous effort while preparing the present opus, but for weeks past I have been puzzled by reports that I have a "new" theory about spraying roses in the rain. A rose grower wrote and inquired about it; a garden editor wanted an article on it. Today the mystery was solved. A letter brought a report of a meeting of the Potomac Rose Society, where someone had read an excerpt from *The Plant Doctor* written about the wet season of 1940. It has been my theory for some time that if you cannot have ideal conditions for spraying you do the best you can with the weather you have; but until reminded today I had completely forgotten I had

put that idea into print. You will find it stated elsewhere in this bug book, put in under the delusion that it was new copy. Doubtless I have repeated myself in many other ways, but if so it means only that time proved the original theories.

I wish there were space to remind you, specifically, of the great amount of information waiting for you, free, at your own state experiment stations or agricultural colleges. In the course of answering your questions during the past years every experiment station in the country has sent me bulletins and circulars. There has never been enough time between questions to send back individual thanks, but here is a collective "thank you." Then there are the splendid publications from the U. S. Department of Agriculture, either free or costing but a few cents.

I have, however, a very special "thank you" to give to the Connecticut Experiment Station for Bulletin 344, *Plant Pest Handbook for Connecticut,* written by the late Dr. W. E. Britton. This is the most useful bulletin for eastern gardeners I have ever handled, and I regret that it has been out of print for some years. I can no longer recommend it to gardeners and, far worse, I cannot replace my own copy, which is so dog-eared with constant thumbing that part of the text is lost.

One other bulletin I single out for mention—the Alabama Agricultural Experiment Station Circular 84, *Insect Pests of Azaleas and Camellias,* written by L. L. English and G. F. Turnipseed in 1940. I used this circular before I ever met the authors and long before I knew I should have the pleasure of sharing their Field Laboratory at Spring Hill, Alabama, for two winters. With azaleas and camellias practically synonymous with gardening in the deep South, this circular is needed by everyone where the winters are mild, and has much useful information for northern gardeners.

I also gratefully acknowledge information received from many books on general gardening or special plants, from many popular garden magazines, including our own *Home Garden,* and from the publications of the American Rose Society, American Delphinium Society, the National Shade Tree Conference, and similar groups. I give special thanks to *Florists Exchange,* a trade paper not available to amateurs, for their habit of giving information immediately on every new development in the field of horticulture. The *AIF News,* put out by the Agricultural Insecticide and Fungicide Association, keeps me up to date on chemicals; *Biological Abstracts* keeps the whole plant field surveyed; and my last bow goes to the *Journal of Economic Entomology,* which provides insect news in the making.

There are many more good books about insects not on this list,

omitted either because I do not own them and so do not use them regularly, or as being somewhat too technical to interest the layman. I do not, of course, frown on getting insect books from the public library. I sometimes bring armloads home, and one wonderful day last fall I borrowed Fabre and Maeterlinck and Howard to reread, for pure pleasure, out at my little cabin in the woods—a day stolen from spraying. I suggest that sometime you try one of these books, but I warn you in advance that once you get your nose in it you are likely to neglect all other pleasures and duties until you put it down. The insect universe is a fascinating one, and not all insects are pests. Indeed, it is probable that we could not exist without them.

ADDRESSES OF AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES

The name of city or town where station is located is given in *italics.* Example: address letter to Maryland State Experiment Station, *College Park,* Maryland.

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Missouri: *Fruit Station, Mountain Grove*
Missouri: *Poultry Station, Mountain Grove*
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Vermont: *Burlington*
Virginia: *College Station, Blacksburg*
Virginia: *Truck Station, Norfolk*
Washington: *College Station, Pullman*
Washington: *Western Station, Puyallup*
West Virginia: *Morgantown*
Wisconsin: *Madison*
Wyoming: *Laramie*

GLOSSARY

Abdomen. The third division of the insect's body. Usually composed of 10 to 11 segments and having no functional legs in the adult stage.

Alternate Host. A second type of plant required for the completion of the life cycle of an insect.

Antenna (*pl., antennae*). Paired segmented organs, borne one on each side of the head, sometimes called "feelers."

Attractant. A material that serves to attract.

Caterpillar. Immature form, larva, of a moth or butterfly.

Cephalothorax. United head and thorax of the arachnida and crustacea.

Cercus (*pl. cerci*). An appendage, usually paired, of the tenth abdominal segment, usually segmented and slender.

Chitin. A colorless, nitrogenous secretion of insect cells, usually soft and pliable; the hard horny part of the insect integument comes from sclerotin deposited in the chitin.

Chrysalis. The pupa of a butterfly.

Cocoon. The envelope, largely of silk, in which many insects pass the pupa stage.

Compatible. A material that can be used with another without counteracting or changing its effect.

Contact Poison. One which is effective upon contact, as contrasted with a poison that must be swallowed.

Cornicles. Two dorsal tubes on abdomen of plant lice (aphids) secreting a waxy liquid.

Coxa. The basal segment of the leg, by which it is joined to the body.

Crotchets. Fine hooks.

Diluent. Inert material used in the preparation of a spray or dust.

Dust. A finely divided or pulverized powder, applied dry.

Elytra. The hard and horny wings of beetles.

Exuvium (*pl. exuvia*). The cast skin of a larva or nymph.

Fascicle. A small bundle or collection; a compact cluster.

Femur (*pl. femora*). The third segment of the leg, counting from the body.

Filiform. Thread-like; like filaments.

Frass. Sawdust-like excrement, often evident at the opening of holes made by borers in plant stalks, trees, and shrubs.

Gaster. Term used for the abdomen of an ant.

Grub. Immature form, larva, of a beetle.

Halter (*pl. halteres*). The knobbed remnants of the hind wings of diptera.

Hibernation. A period of suspended animation in animals during seasonal low temperatures.

Honeydew. A sweet substance secreted through the anal openings of sucking insects; *e.g.*, aphids, mealybugs, scales, whiteflies.

Host Plant. Plant attacked by, or supporting, insects or diseases.

Inactivated. Made inactive or inefficient.

Instar. The period or stage between molts in the larva or nymph, numbered to designate the various periods; *e.g.*, the first instar is in the stage between hatching and the first molt.

Labium. The lower lip

Labrum. The upper lip.

Larva. The immature form of insects with complete metamorphosis. The wingless, often worm-like, stage between the egg and the pupa. Larvae of moths and butterflies are caterpillars; of beetles, grubs; of flies, maggots.

Maggot. Immature form, larva, of a fly.

Mandible. The first pair of jaws in insects.

Maxilla (*pl. maxillae*). The second pair of jaws in insects.

Mesothorax. The second division of the thorax.

Metamorphosis. The changes undergone during growth of insects.

Metathorax. The third division of the thorax.

Molt. Shedding skin or other covering of body in process of growth.

Nocturnal. Flying or feeding by night.

Nymph. The young of insects having incomplete metamorphosis.

Ocellus (*pl. ocelli*). The simple eye in insects.

Oviparous. Reproducing by eggs laid by the female.

Ovipositor. A specialized organ in insects for depositing eggs.

Ovisac. An egg case, notable in mealybugs and some scale insects.

Ovoviviparous. Producing living young by the hatching of the egg while still within the mother.

Parasite. Insect living on, in, or with the host plant, at whose expense it obtains food.

Parthenogenesis. Reproduction by the development of the unfertilized egg.

Pedicel or *Petiole*. The "waist" of

an ant; segments by which the abdomen is attached to the thorax.

Predator. Insect which attacks or destroys another.

Proleg. One of the fleshy "false" legs on the abdominal segment of some insect larvae.

Prothorax. First segment of the thorax.

Pulvillus (*pl. pulvilli*). Soft, pad-like lobes between the tarsal claws.

Pupa. The resting, usually inactive instar in all insects with complete metamorphosis.

Puparium (*pl. puparia*). The thickened, hardened last larval skin in which the pupa is formed in the Diptera or flies.

Segment. A subdivision of the body, or an appendage between areas of flexibility with muscle attachment.

Spinneret. Organ used by certain insects in spinning webs or "silk."

Spiracle. A breathing pore; the opening to a trachea.

Spray. A liquid dispersed in fine drops.

Stem Mother. Female aphid giving birth to living young without fertilization.

Stipe. A short stalk or support.

Stomata. Minute breathing pores or apertures.

Tarsus (*pl. tarsi*). The jointed appendage attached at the apex of the tibia, bearing the claws and pulvilli of the insect "foot."

Tegmina. Hard fore wings of grasshoppers.

Thorax. The middle of the 3 main divisions of the insect body; between the head and the abdomen.

Tibia (*pl. tibiae*). The fourth division of the leg.

Tolerance (in sprayed fruits or vegetables). The amount of a spray or dust which can be left as a residue on harvested fruits or vegetables without danger when they are used for food.

Trachea (*pl. tracheae*). A spirally ringed internal elastic air tube in insects; an element of the respiratory system.

Trap Crop. A crop (usually planted in advance) employed to lure insects that can be destroyed before they have a chance to attack the crop which it is desired to protect.

Triungulin. The first larval stage of a blister beetle.

Tubercle. A small, knob-like prominence.

Vector. A carrier of disease-producing fungus spores, bacteria, or virus.

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